PROCEEDINGS

OF THE

SANITARY ASSOCIATION OF SCOTLAND.

WITH

PAPERS

READ AT THE ANNUAL MEETINGS, HELD AT PERTH, JULY, 1890.

EDITED BY

JAMES CHRISTIE, A.M., M.D.,

LECTURER ON HYGIENE AND PUBLIC HEALTH, ANDERSON'S COLLEGE MEDICAL SCHOOL, GLASGOW;
EDITOR OF "THE SANITARY JOURNAL," ETC.

PUBLISHED BY
THE SANITARY ASSOCIATION OF SCOTLAND.
GLASGOW: ALEX. MACDOUGALL, 81 BUCHANAN STREET.
1890.

PREFACE.

At a meeting of the Council of the Sanitary Association of Scotland, held shortly after the annual meeting at Perth in July last, it was resolved to publish the proceedings of the meetings, and the papers read; and it was arranged with the editor and publisher of the *Sanitary Journal* to have, for this purpose, reprints from the *Journal.*

The object of the Sanitary Association, in issuing in pamphlet form the proceedings of the Association, is to bring more prominently than heretofore before those who have, or who ought to have, a special interest in sanitary matters—viz., Medical Officers of Health and Sanitary Inspectors, and also County Councillors—the important work being done by the Sanitary Association of Scotland.

Seeing that Scotland has now entered on a new era of sanitation, it is to be hoped that the sphere of influence of the Association may be correspondingly enlarged, and that the various officials mentioned may see it to be their duty to become members of the Association.

The Association meets annually in different large centres of population in Scotland; and it has been suggested, at various times, that branches should be formed in connection with adjoining counties, and that at the meetings held popular lectures should be delivered. This latter most useful project could easily be accomplished when the County Council appointments have been made, and when the new machinery has been set in working order. The advantages to sanitation would be immense by the carrying out of such a scheme as this.

The annual and district meetings of the Association would form a basis of union for the various counties, resulting in uniformity of methods of work, healthy stimulation, and a steady advancement in sanitary science.

In addition, the work of the Scotch county officials can always appear, and be put on permanent record, in the pages of the *Sanitary Journal,* the organ of the Association.

The next meeting of the Association will be held at Edinburgh in autumn, and it is expected that the meetings will be large and influential owing to the expected presence of the County representatives, in addition to those from the various Local Authorities in Scotland.

J. C.

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APPENDIX.

THE ECONOMY OF THOROUGHLY EFFICIENT SANITATION.

By CHARLES CAMERON, M.D., LL.D., M.P.

Through the recent death of my venerable friend Sir Edwin Chadwick, who was justly regarded as the father of public sanitation in the United Kingdom, whose enthusiasm in its pursuit years could not quench, and from whom I received a proof of a paper on his favourite subject only a few days before I read the announcement of the brief illness which carried him off—in the death of my old and esteemed friend, even at the ripe age of four score and ten, the cause of public sanitation in this country has sustained a severe loss. And I have thought it fitting to base my remarks to-day to a large extent upon the topic of that loss, not only because Sir Edwin for so many years occupied the position of President of the Association of Sanitary Inspectors of Great Britain, and because his annual appearances in that capacity must have familiarized him to many of you, but because I feel that I can most effectively illustrate the importance of the work of sanitation in which you are engaged by drawing largely upon the materials which his long experience had enabled him to accumulate, and by placing before you facts and figures for which I am indebted to him. A vast amount of sentimental platitudes are talked about the comparative nothingness of money considerations to questions of life and health; but Sir Edwin Chadwick saw the people stricken down by hundreds of thousands by disease, which a moderate and well directed outlay might have prevented, and he knew that it was not to these empty professions of benevolenee that he must appeal if he would practieally advance his views. He heard leaders of public opinion re-echoing the fatalist doctrine of Malthus, that the poverty, starvation, and disease among us were due to over-population, and he set himself to prove that so far from Malthus being right he was wrong on every point on which his theory was based. With the enormous

improvements which invention has brought to the aid of our powers of production, the average wages earning power of the Lancashire population had, since the time of Malthus, multiplied itself by three, and that of the agricultural population of Scotland by more than two. So far from the productive limits of agriculture in the United Kingdom having been reached, it might still be doubled. In India alone, that land of periodic famines, there are still some eighty millions of acres of cultivable land not utilised, and the rate of produce might be increased to provide for an additional population of 400,000,000; and it was absurd to talk of pressure of population on the means of subsistence as the cause of so many woes when only one-sixth part of the cultivable portions of the earth are as yet taken up. Just as absurd was it to rest content with poverty as the cause of our high mortality among a population which boasts an annual drink bill of £100,000,000 sterling, while by far the lowest death-rate among them is found in the cheaply fed and hungry inmates of our prisons. The idea that recurrent epidemics and a high death-rate are the provisions of Nature against redundancy of population Sir Edwin laughed to scorn. "In investigating the subject of poor law relief," he writes, "I found that in the healthy agricultural districts the interval of births, when the mothers suckled their own children, was about 2½ years, and that where there was a family of 8 children, the eldest would be 16 years of age, the second 14, and the third 12, capable of earning their own subsistence. In the depressed districts, on the other hand—the slums of the metropolis, most heavily ravaged by the epidemics—the intervals of birth, are only one year. Extended experience shows that, except in such extraordinary cases as the Black Death, pestilences do not diminish population, but only leave it weakened. As health and the duration of life are advanced the proportion of births appears to be rather diminished, as in the well-to-do classes. It is shown that where wages increase the pressure of the population on the means of subsistence is diminished—that instead of the cost of production of land being fixed, it is generally reducible largely by science and machinery, whilst the amount of produce may be everywhere largely augmented—that instead of pestilence being a natural check to population it does not diminish that pressure, but serves to weaken population and diminish its productive power." And so, he argued, the time was long distant when a healthy and educated adult would cease to be a valuable asset in the balance sheet of the commonwealth, and until that time arrived, independent of every consideration of pain and sorrow which attaches to disease and death—considerations which mankind, to fully realise, must have brought to their own individual doors — my old friend argued, and in this I thoroughly agree with him, that no investment of the national wealth paid like that directed to combating the causes of disease — that

experience had shown that the work of public sanitation, the work which it is the business of your lives to carry out, is not only, from the humanitarian point of view, among the most blessed and noblest of all works, but that it is the most remunerative and profitable for the state of any undertaking on which the public money is expended. And how did he prove this? Soldiers are enlisted to be food for powder. Their lives are deemed as naught when weighed in the balance with the crotchets of squabbling kings and statesmen; and the money value of a soldier's life is what it costs to make a soldier. The money value of a soldier is £100. In the olden days our barracks were ill-drained, ill-ventilated, badly supplied with water and full of sanitary defects. The result was a high death-rate and a proportionately large number of soldiers constantly in hospitals sick. The importance of sanitation was taught to our military authorities by the terrible lessons of the Crimean Campaign, and a vast improvement in the conditions under which our army was housed had been effected by 1869. After 10 years' experience of the improved condition of matters, Professor de Chaumont of Netley drew up a tabular statement of the saving effected by it, and here was what he found. The old death-rate in the Indian army had been 69 per 1,000, and at that rate, on the average strength for the 10 years 1869-79, 4,000 soldiers would have died every year. But by means of sanitation the actual death-rate had been reduced to less than 20½, and only 1,181 had died, showing an average annual saving of 2,813 living soldiers, or £281,300 worth of fighting men. Besides this, the aggregate number always sick had been reduced from a hundred to 56½ per 1,000, and 2,508 men per annum thus released from hospital to their duty in the ranks. I need not trouble you with the details of the professor's figures for the home and colonial armies. Suffice it to say that in the former the mean annual death-rate had been reduced from 18 to 8·84, and in the colonial army from 30 per 1,000 to less than 11, showing a yearly saving in living soldiers as compared with the loss under the old state of things of close on 1,400 men, worth £140,000, besides a considerably larger number of effective men added to the ranks through the diminution in the aggregate number always sick. In the 10 years 1869-79, during which the nation had been reaping the profit of her expenditure on sanitation for her army, that profit had amounted to £4,098,000 in the shape of 40,980 soldiers saved from death, besides an increase in our effective strength of 4,000 men by the number formerly constantly sick, who by improved sanitation had throughout the period been maintained in good fighting condition.

Some portion of this saving, and probably still more of the further saving which has been brought about since Professor de Chaumont made his calculation, must of course be credited to the progress made in curative medicine and surgery; but the utmost

which curative medicine can accomplish is infinitesimally small when compared with the wholesale results which follow an adoption of the teachings of preventive medical science in the direction of enlightened sanitation. The death-rate of our army still leaves much room for improvement. There is no reason—there can be no reason except defective sanitation—why among our troops at home it should exceed the 5 per 1,000 which is now the normal figure of the German army. We have still a large margin to work upon before that figure is attained; and I am convinced that, for the large expenditure for new barracks on which this country is about to embark, it will find a vastly more remunerative investment, so far as increasing its fighting strength is concerned, than could be obtained by any equal investment in either forts or ships. For of one thing there can be no doubt, from the figures I have quoted, as a mere commercial investment sanitation pays; and if it pays in military life, it pays even better in civil life, though the results are not capable of being so clearly estimated in pounds, shillings, and pence. But to borrow another example from the great sanitarian who has just gone from among us. In 1880 the death-rate for England and Wales was 20·5 per 1,000; in 1888 it had been reduced to 17·6. Dr. Farr has worked out the average economic value of a life to the State at £159; and at that computation the saving of life to the nation in the last, as contrasted with the first of those nine years, amounted to over seven and a half millions of pounds sterling, or close on the sum annually raised in England in the shape of poor rates. And is there one of you, who is familiar with the enormous disparity between the death-rate in the slums and the healthier portions of our large towns, who will hesitate to endorse the contention that there is no insurmountable reason why our present rate of mortality should not be reduced by at least 5 per 1,000, and a saving in the most precious asset of the State, the health and strength of an abounding population, be brought about, which would repay a thousandfold any sacrifices and outlays which it might cost?

Gentlemen, there is a great future before the work in which you are engaged. The intelligent public is daily becoming more and more alive to its urgent importance. The legislature is yearly becoming more sensible of its necessity; and, although at the hands of those with whom you have to deal, your efforts for their benefit may not always meet with grateful recognition, you have at least the right to this great consolation, that the work in which you are engaged is a noble and a patriotic one—the rescue from disease and death of countless fellow-creatures, and the building up, more than it can be built up by any other means, of the health and happiness of the nation. Your time for praise will come when your work is reviewed by another generation, and meanwhile you must remember that it is not the prophet only who is devoid

of honour in his own country. Naturally, the work of the medical or the sanitary officer involves him in a considerable amount of friction. He has to interfere with the dirty and disease-fostering habits of tenants ignorant of the importance of fresh air and cleanliness, and to prescribe measures which often entail on them trouble which they abhor. He has to interfere with the gains and indifference of ignorant, careless, and greedy landlords, and it is often his duty to make demands upon the public purse which are not particularly agreeable to the authorities or the ratepayers whose money they expend. But a great work cannot be carried through without a certain amount of inconvenience and expenditure; and, as the best sanitary legislation is that which will obtain the maximum of benefit with the minimum of irritation, so the best sanitary administration is—not that which is the most ambitious and profuse—but that which aims at achieving the greatest results with the minimum of inconvenience and expenditure on the part of those with whom it has to deal. Now, there was one principle on which Sir Edwin Chadwick strongly and consistently insisted—that, if you would obtain the best results as regards the saving of life, as in most other things, you must not rely exclusively or mainly on the effects of any precautions that an administration can take, but must invoke the assistance of private interest to bring about what you desire. "When the system of transportation to the Colonies for crime was first adopted," he writes, "in some of the earlier voyages nearly one-half of those embarked were lost and thrown overboard. Later on, in the passage to New South Wales in the *Hillborough*, out of 306 who embarked 100 were lost; and in another ship, the *Atlas*, out of 175 who embarked 61 were lost. Yet there were no omissions palpable to common observation, or which could be distinctly proved as matters of crimination to which responsibility could be attached. The skippers were no doubt honourable men, but their thoughts were directed solely to profits. Well, a change was made from payment on the number of convicts embarked to payment only on the number of convicts landed alive and well. The effect was extraordinary; the skippers themselves, without any official supervision or regulations, appointed medical officers, and put the whole ship under their charge. Endorsing the soundness of the principle, they applied it to their own ship surgeons, whose remuneration was made dependent on the number of persons landed alive and well; and the sailors were included under the same contract as the convicts. The general effect of the interest in this practical application of the preventive principle was that the death-rates were reduced to about 3 per 1,000, or less than half the lowest death-rate the passengers must ever have had on shore." Now, I must say that although on shore it is a more difficult matter to apply this principle of self-interest than, in the case just quoted, afloat, it is a principle

which, if we wish to succeed, we must bear constantly in mind; and therefore I have no sympathy whatever with the outcry raised by the owners of unsanitary dwellings at what they maintain to be an infringement of the rights of property, in the enforcement at their expense of such structural improvements, or such limitation in the number of tenants allowed to be housed, as may be required to bring the property which they own and control up to a good sanitary standard. And I have still less sympathy with tenants who complain of being harassed and persecuted because they are so dirty or so careless that they will not comply with the most obvious dictates of order and cleanliness.

In a civilized country no man has a right, through his property or his actions, to constitute himself a danger and a nuisance to the health and well-being of the community among whom he dwells, and if he cannot be prevailed upon to do all that in him lies to promote the health of his neighbours by a conviction that compliance with sanitary requirements pays, he must be reached by convincing him that at all events neglecting them does not pay. When this lesson was taught to the skippers of whom I have just spoken, far from resenting the interference and advice of sanitary officers, they became eager to obtain their suggestions; and when you shall have succeeded in inculcating the same lesson on those concerned on shore, the same beneficial result will be obtained. I am quite aware that there are certain plague spots in our sanitary system which can only be got rid of by considerable expenditure of public money, and I should be the last to grudge public money judiciously expended for such a purpose. But to render its expenditure any better than waste, it must be expended with a sole view to the great object for which the expenditure has been incurred, and it must be expended with a constant regard to the susceptibilities of mankind. And a long and close observation of the matter has convinced me that it is owing to neglect of these fundamental doctrines that the enormous expenditure of public moneys which, within the last score of years, has in the United Kingdom been made on sanitary objects, has not achieved much greater results than those of which we can yet boast. There is a tendency in central administrative departments to lapse into unintelligent routine, ignoring alike the advances of science and the most notorious peculiarities of human nature; and in local administration for departments to launch into costly experiments with which the name of some prominent citizen can be associated, often ignoring the main consideration for which they have been undertaken, and neglecting matters of the highest moment to the health of the communities concerned, which could be set right at a mere nominal cost.

To illustrate the dangers to which I have called your attention, in connection with central administration, look at the case of small-pox—a disease the suppression of which falls particularly

within the function of the sanitary authorities. You are all familiar with the enormous value of vaccination as a means of combating that disease. Well, in England there is a central establishment carried on at a large expense for the purpose of preventing small-pox by vaccination. In the shape of salaries, to its own immediate officials and its departmental expenses, it costs close on £4,000 a year, and it distributes another £16,000 a year in the shape of bonuses to public vaccinators for the best results from vaccinations, awarded on the report of Government inspectors, according to a standard which the department has laid down. In Scotland there is a modest central department costing but £300 a year, exclusive of an allowance for office accommodation—an item not included in the charge on the estimates in the case of England. If Scotland were subsidized from the national exchequer at the same rate as England in proportion to her population, she would be entitled to nearly ten times as much as she receives. As a matter of fact, so small a part does the little Edinburgh establishment play in the great work of anti-small-pox sanitation, that it might, I believe, be altogether dispensed with without any visible result. And yet, what do we find as to the success which has attended the efforts to keep small-pox in check in the two countries? We find that in Scotland, for the last 15 years, there has been nothing approaching to an epidemic of small-pox. We find that since 1874, when the last epidemic occurred, the death-rate has continuously decreased, until in 1887 the number of deaths in that country was only 8, or 2 per million of persons living, and in the last year for which we have the Registrar-General's figures, 1888, the disease did not carry off one single victim. What has been the experience of England during the same period? She suffered from outbreaks of small-pox in 1877-8-9, and in 1882-3, and again in 1885-86. In Scotland the average annual death-rate from the disease during these 14 years was 5 per million persons living. In England it was 63. In 1888, while we with our four millions of population had not a single death, in England the deaths from small-pox exceeded 1,000, and that means 15 or 20 times that number of small-pox cases. It means the seeds of small-pox constantly kept alive and the materials prepared for an epidemic outburst, whenever the conditions of the time chance to give an impetus to the development of the disease. It is not that in England the expenditure of public money in the different localities for purely local work in connection with small-pox is stingy or restricted. On the contrary it is lavish, so lavish that I venture to say that in London alone, with a population about equal to that of Scotland, the expenditure of the Metropolitan Asylums Board has exceeded that of Scotland as much as the cost of the English central establishment exceeds that of the Scotch. The conditions for the spread of the disease are more

favourable in Scottish towns than in those of the sister country, owing to the customary congregation of large numbers of families in a single tenement, and yet the results are the very reverse of what would *à priori* be expected. And why? Simply for this reason, that in England you have a centralised system of routine, and in many cases a deadened local self-interest owing to defective municipal organisation; while in Scotland, in this matter at least, we are practically free from the enervating influence of official red tape, and our popularly elected Local Authorities entertain a very lively sense of self-interest as to the necessity of adopting every available method of stamping out a disease which, if allowed to spread, they know will cost them dear in lives, and sickness, and rates. In Edinburgh, Glasgow, and Dundee, and I believe in every other Scottish town of any importance, on the announcement of a case of small-pox the sanitary authorities are at once on the alert. Every opportunity and inducement for separating the sick is afforded, revaccination is offered on the spot to any one who has been exposed to infection and contaminated rooms, and infected clothing are cleansed and disinfected. Contrast this with what occurs in London. I had the subject forcibly brought before me during a late epidemic there by a servant of mine, who lived outside with his family, and who took the disease. I at once reported the case to the medical officer of health and suggested that no time should be lost in removing the patient to an hospital, in disinfecting the house in which he lived, and in offering revaccination to its inmates. I was told that all the public hospitals were full but that he could be received at another institution on payment of £4, a demand with which I readily complied, but which, in the case of most working men, would have proved an insurmountable obstacle to removal. As to revaccination that was out of the medical officer's department; but he would report the case to the vaccinating officer; and as to disinfection the case would be reported to another officer whose duty it was to look after that. The £4 being paid, the patient was removed, but though the case was reported for purposes of disinfection and revaccination as promised, nothing whatever was done. I afterwards learned that with a view to encourage revaccination the central authorities issued hand-bills to the public, informing them that by applying at certain stations at certain hours on certain days of the week, the operation would be performed gratuitously. Now, to take advantage of these so-called facilities would entail an average journey of a mile or more, often at an hour when time was precious, and, with your experience of the small amount of trouble which will deter the public from taking precautions to protect themselves against disease, I need hardly say that it utterly failed to secure revaccination to the very class in whose protection the public had the strongest interest; those, namely, who had directly come into

contact with the infection. So long as the present routine system is allowed to remain, England, notwithstanding all the lavish expenditure, will never achieve the mastery over the disease which has been achieved in Scotland. Brain in these matters is more important than money, and brain it is, without money, that has achieved the victory in Scotland.

Again, to illustrate what I said as to the weakness of public expenditure as a motive agent in sanitation, as compared with that self-interest on which Sir Edwin Chadwick so urgently insisted, let us take the case of Glasgow. That city, as you know, was one of the first, if not the first, in Scotland to adopt a great improvement scheme, and yet its death-rate, I regret to say, despite the great zeal and ability with which, under Dr. Russell and Mr. Fyfe, its sanitary administration is carried out, is disgracefully high—much higher than might have been secured by the enormous cost actually incurred. In the midst of an ambitious scheme, the primary object of the outlay was lost sight of. That object should have been to promote the sanitary housing of the working classes. Well, at the very commencement of the building operations I remember two incidents which speak for themselves. In the first place, the medical officer of health—not Dr. Russell then, but his predecessor, Dr. Gairdner—complained that a number of houses had been built, or their plans adopted, without his ever having had an opportunity of pronouncing on their sanitary arrangements. In the second, Sir Sidney Waterlow, a gentleman who had devoted much attention to the improved housing of the working classes—chairman of a company which even at that time had erected numerous magnificent workmen's houses in London, and which has since studded the metropolis with many splendid and healthy piles of similar dwellings—a philanthropist who had managed to solve the economic problem, without solving which no practical results can be hoped for of making these workmen's houses pay—visited Glasgow for the purpose of purchasing from the Improvement Trust sites on which to carry out in that city a similar scheme. But the price on which alone the Improvement Trust would part with land for this, the fundamental object of their whole operations, was so high, that on making his calculations Sir Sidney found that the scheme which he has so successfully and on such a gigantic scale been instrumental in carrying out in London, could not be made to pay, and Glasgow, with all her lavish expenditure, missed an opportunity, the embracing of which would ere this have been productive of untold good, and which can never be offered to her again.

And now, to come to the last drawback which I have mentioned in connection with local expenditure, when contrasted with self-interest as a motive-power in sanitation—the tendency to grudge small expenditures which might be productive of enormous good because they are not showy. Again, I shall take my illustration

from Glasgow, where, as I have said, the death-rate is still so high, and where such huge expenditure has been incurred in endeavours to cope with it. I read with great pleasure a report which Mr. Fyfe was kind enough to send me of the operations of the sanitary department in that city during the year 1889, and therein I found the record of an immense amount of work done, comprising amongst other things 2,774 cases of drain-testing. Well, I need not, in addressing you, insist on the very great influence which defective drainage and the introduction of sewage-gases into dwellings has in the promotion of disease. With all our discoveries as to the possible convection of typhoid by milk, of cholera by water, or diphtheria by cats, there can, I think, be little doubt that sewage gas conveyed into our houses through a network of defective drains and pipes, is at the present moment responsible for more preventible disease than all other causes combined. Of course we all know that this is due to the fact that in fermenting sewage all sorts of disease germs find a congenial breeding ground, and that, carried by sewage gases into our dwellings they find their way into our food or drink and our bodies, and give rise to most of the great and terrible class of zymotic diseases. Thus the introduction of the system of sinks and baths, and water-closets, if unaccompanied with stringent attention, to make sure that the drains and soil pipes are properly trapped and in good condition, introduces a new danger into our midst by establishing a series of conduits through which the germs of disease are carried direct into our houses from their great breeding field in the network of sewage which communicates with every portion of our towns. That this is no fanciful danger was proved by my late friend, Dr. Fergus of Glasgow, who showed conclusively by elaborate statistics that the incidence of many formidable zymotic diseases in the different streets and districts of that city had been materially altered by the introduction of the water-closet system, that maladies previously but little experienced in the healthier districts had been largely increased in these districts, without a corresponding increase in the slums, where the system had not been introduced ; and, who, from houses where outbreaks of these diseases had occurred, had collected quite a museum of perforated soil pipes which he rightly looked upon as having afforded an entrance for the sewer-gases which had borne with them the germs of the diseases by which his patients had been prostrated. Now, it is quite clear that the house drainage in our large towns is in a sadly defective state. From Mr. Fyfe's statistics, I find that out of 1,034 inhabited tenements in Glasgow in which the drains were last year tested for the first time, in only 77 instances were they found all right. In other words, out of every 27 inhabited tenements examined, in 25 cases the smoke test showed the drainage to be defective, and the existence of communication between that ramified hot-bed of disease germs.

which exists in our sewers and the interior of the dwellings in which the population live. Now, it is perfectly clear that if you could, by means of disinfectants or antiseptics, prevent the germination of disease organisms in our sewage and kill such as found their way into it, although certain smells and emanations from sewers might still enter our dwellings they would be harmless, and although our drainage might remain as defective as it is, if this disinfection of our sewers' contents could be brought about, the same result would be obtained as would be brought about by the substitution, for our present most imperfect sewage arrangements, of such a perfect system as would prevent the possibility of any sewage-gas invading our dwellings. Well, such an experiment in sewage disinfection on an extensive scale has been made, and its results enable us to judge of the results that might be obtained by adopting the equivalent method of establishing a gas-tight drainage system. The experiment to which I refer was all the more valuable because it was intended for a totally different purpose, and the results to which I shall call your attention came out incidentally. It occurred thus. In 1866 an epidemic of cholera raged in England. Among the towns which had suffered heavily in previous visitations of the disease was Bristol, in which in 1849 close on 2,000 persons had been carried off. Now Bristol in 1866 had the good fortune to be advised by Dr. Budd, the physician who laid the foundation of our knowledge of typhoid fever—a scientist far in advance of his age, and whose deductive penetration enabled him, a score of years before the labours of Pasteur had familiarized us with the intimate nature of zymotic diseases, to formulate as theory much of what has since become demonstrated fact. Bristol had at that time the further advantage of having as its health officer Mr. David Davies, a gentleman of high intelligence and boundless energy. Now, Budd believed in the theory, since universally admitted, that cholera is propagated, among other means, by the multiplication of its germs in our sewage; and when, in 1866, Bristol was threatened with an invasion of that disease, one of the preventatives on which he laid greatest stress was the thorough disinfection of all drains and sewers. Disinfectants were provided gratis by the authorities, and visitors were appointed to see that they were used for the disinfection of water-closets, and drains, and cesspools. They were poured into the sewers, and the whole sewage network of the city was formed into a soil in which disease germs could not live, and in this condition it was kept for seven months. During those seven months the condition of Bristol was, so far as regarded sewage-bred diseases, precisely as if all structural defects in its drainage system had been got rid of. And what was the result? I do not speak of it so far as cholera is concerned. As regards that, the precautions taken were perfectly successful, for although several cases found their way into the town, the disease never

spread. But what was the result in relation to zymotic disease generally, regarding which no one had concerned himself with when the experiment was undertaken? Why this, that for the seven months during which the system was kept in operation in the large, and in many parts squalid, town of Bristol, where the mortality even at this date is between 19 and 20 per 1,000, the death-rate fell to the average of 12 per 1,000 per annum; whilst the parish of Clifton, with more than 20,000 inhabitants, passed an entire week without a single death. And all this was effected at a cost to the town for disinfectants of some £600. Now, gentlemen, this experiment gives us some idea of the enormous result that might be obtained in the direction of diminished sickness and death-rate by the detection and remedy of the innumerable sewage defects which Mr. Fyfe's figures show to exist in towns where the mortality is highest. Under the law as it stands, in our towns at least, defective drainage is a nuisance which the authorities are empowered to insist on being got rid of. When the outbreak of a disease leads to suspicion of the existence of that nuisance they take steps to unmask it; and with that object, as I have told you, in Glasgow last year Mr. Fyfe reports that the smoke test was applied to 1,034 inhabited tenements, besides some 78 in which it was applied to new buildings, so as to make sure that the drainage was all right before they were passed by the Dean of Guild Court. Now, from what I have said, you may judge that I am not an advocate of worrying and annoying the public in matters of sanitation more than is absolutely necessary for the general safety. I should be sorry to suggest that it should be made part of your duty to break into the drains of every unsavoury house and apply the smoke test. These matters require to be gone about judiciously, and in such a manner as to avoid revolting public sentiment. But I would say that so long as a local sanitary authority neglects to do everything in its power to induce the community for whose sanitation it is responsible to improve their drainage—so long as it refuses them every assistance in detecting defects and every advice as to remedying them —it fails to fulfil one of its most obvious and important duties. And if, for the purpose of saving a few paltry hundreds a year, it refuses that assistance and that advice, while on the other hand it expends enormous sums in structural work intended to reduce mortality, its action illustrates that prevailing vice of local sanitary authorities to which I commenced by calling your attention—profuse and often ill-judged expenditure in ambitious schemes combined with parsimony in matters where much greater economies of life and health might be secured at infinitely less cost by appealing to the proper motive power of individual self-interest. Now, what inducement has Glasgow, for example, in which hundreds of thousands of pounds have been spent for sanitary purposes on land and brick and mortar, and whose death-rate is still so

discreditably high—what inducement has she held out to persons desirous of ascertaining whether the drainage of their houses was what it should be. "The benefits," writes Mr. Fyfe, "of an assurance from the sanitary department that the drainage is right and no danger to be feared from the entrance of sewer gas, has lately led both proprietors and tenants to make application for a smoke test, although they have no immediate grounds for believing that sewer gas is finding its way into the house. It has hitherto been my custom to refuse all such applications, as my inspection is a legal proceeding, and based upon a reasonable suspicion of nuisance. As our present staff is unable to cope with such demands, the matter has been referred to your Honourable Board, and is under consideration. The main argument in favour of testing 'on request' is that it is too late to find a flaw after disease or death from blood-poisoning, enteric fever, or diphtheria has drawn attention to the suspected cause. The argument against it is the extra staff required and the expense entailed for work which will fend the proprietors of property from the full onus of responsibility." It is of course not the duty of a sanitary inspector to attempt to dictate to the local authorities in whose employ he is, and Mr. Fyfe may have been bound in fairness to state the arguments adduced against as well as those in favour of the proposal; but I cannot help believing that a man of his intelligence must have recognized the absurdity of the last objection, which states that inspection on demand would absolve the property owner from his full burden of responsibility. Why, what responsibility has he? When his tenants have been poisoned and his neighbour's tenant killed through his defective drains, what responsibility has he save that of making the drainage good? And if he has previously asked inspection and it has been refused, and he has thus been prevented from acting on the impulse that would have led to the prevention of the mischief, it seems to me that the onus of moral responsibility will rest very lightly on him as compared with the Board that, entrusted with powers of assessment for sanitary purposes and exercising them freely when it suits their taste, attempt by their petty economy in a most vital matter to compound for waste at the bung by parsimony at the spiggot.

Did time permit I might advert to another easily suppressed nuisance, for the suppression of which ample powers exist, and the reduction of which could not fail to be attended by the most beneficial results in the health of our large cities. I refer to the smoke nuisance. The importance for health of a clean and unpolluted atmosphere, as well as clean surroundings, is shown by the fact that in our navy, notwithstanding all the hardships and vicissitudes of climate which our seamen have to encounter, the death-rate from disease is only half what it is in our home army—is largely less than even that of which the German army

boasts. And when I see the disgraceful state of the atmosphere in many of our principal Scottish towns, I am convinced that a large improvement in public health as well as in public comfort might be effected were our local authorities to display only a fraction of the firmness in dealing with the rich manufacturers, chiefly responsible for this smoke, that they display in dealing with the poor, who at anyrate are themselves most directly the sufferers from such nuisanees as they create. The means have been invented by which, at comparatively small expense, the smoke nuisance can be vastly limited, if not altogether got rid of, and you have only to enforce the law that manufacturers must cease to create that nuisance for means to be forthcoming to put Glasgow and Paisley, Dundee and Greenock, into as satisfactory a state as has been brought about in London. But, gentlemen, I have already trespassed too long on your time. I might have easily addressed you on more novel and possibly more interesting topics connected with sanitary science, but my object has been to inculcate a few fundamental principles of public sanitation on which the distinguished sanitarian whose death I commenced by referring to laid supreme stress—to show that, much as has been done, much more remains to be accomplished; that the best results ean be assured in sanitary work, as in most other matters of administration, by following up, whenever possible, the line of least resistance; that expenditure and efficiency are by no means synonymous terms; and that, for motive force, subventions for public funds are as nothing when compared with self-interest. These fundamental principles cannot be too often enunciated or too clearly recognized, and precisely as their recognition becomes more general—as it permeates our legislature, our Police Boards, our Managers of the Poor, and our County Councils—will the importance of the Medical Officer of Health and Sanitary Inspector as the guardians of life and health be recognized, and their position and status be exalted and improved.

[In what he called the postscript to his address, Dr. Cameron said their position as sanitarians was about to be recognised in a way in which it had never been before, and he congratulated them upon the fact that, by the provisions of the Local Taxation, Customs and Excise Bill, a sum of £14,000 or £15,000 was to be set apart for the benefit of medical officers and sanitary inspectors in Scotland. In this way the anomaly which existed between England and Scotland would be removed, and he trusted the money would be distributed by the Secretary for Scotland in such a manner as would effectively put an end to that state of things in which sanitary inspectors were paid one, two, three, four, or five pounds for the discharge of their most important duties, and tend still further to improve the very creditable position, in regard to sanitation, which Scotland already held among the nations of the world.]

ON THE POSITION AND WORK OF A COUNTY SANITARY INSPECTOR.

By PETER FYFE,

Sanitary Inspector, Glasgow.

> "I search and search, and where I find I lay
> The wisdom up against a rainy day."—*Horace.*

Since the Local Government (Scotland) Act, 1889, became law, much has been written on the position and duties of the county medical officer of health. If the Board of Supervision, County Councils, and medical gentlemen have not yet obtained an all round and clear view of this officer's position, and the functions he may be called upon to exercise, it will not have been the fault of those medicals who have so ably tried to enlighten them. It is the object of this paper to present to view another sanitary official whose image has more or less been lost sight of in the light which has been spread around his medical colleague. We refer to the sanitary inspector of a county in Scotland. What is *his* position, and what *his* work in the regeneration of Scotland to a truly hygienic condition?

This position and this work or duty must not be confounded with his requirements in physical and sanitary science, and the knowledge he ought to possess of the various laws of the country dealing with public health. Specific duties are one thing, and abundant and correct knowledge is another. The duties which can legally be imposed upon all medical officers of counties are, or ought to be, precisely the same. Personal duty of acquirements in sanitary science should also be the same in those who aspire to this position; but, alas! the acquirements are often per individual very dissimilar. The same remark applies to the legal and personal duties of county sanitary inspectors. The law and the authorities mark out the officials' sphere and duties, and County Councils may be trusted to discover the men whose acquirements

are such as to warrant them in filling the respective positions. Let us, therefore, avoid the mixing of legal and personal duty. They have been so commingled in late writings on the subject, as it bears upon the medical officer of health, that that official appears not only as the medical expert and statistician, but also as capable and ready to exercise the functions of burgh surveyor, sanitary engineer, cleansing superintendent, and head sanitary inspector. Now, an intimate acquaintance with the principles which form the basis of the work of these various officials may be requisite in any well equipped medical officer of health, and the more he knows in the detail of such work the better official he will be in his own sphere. His sphere will be touched upon incidentally as we proceed to elaborate that of the county sanitary inspector.

The 52nd Section of the new Local Government Act is so explicit in its terms as to the necessary appointments, that no further reference need be made to it than to say that it gives the basis of the new officials' sanitary administration. That basis is a level one, so far as the independence and responsibility of the medical officer and sanitary inspector are concerned. No duties are specifically assigned to either officer by the Act itself, except that of reporting his work to the County Council and the Board of Supervision, so that the duties and positions assigned to each under the Public Health (Scotland) Act, 1867, are untouched. It is to this Act, therefore, and the Byelaws recommended by the Central Board, that recourse must be had in trying to define the true sphere of a sanitary inspector for a county.

In reverting to the 8th Section of the Public Health Act, we find that local authorities "may make byelaws for regulating the duties of such inspectors and medical officers, which byelaws shall not be effectual until they are approved of by the Board." Dr. Skelton, the Secretary to the Board, in his able *Handbook* published this year, makes several notes under this Section referring to the duties of these officers. He says (p. 12), "The duties of medical officers are set forth in general terms by the byelaws recommended by the Board—unless required by a regulation or byelaw, or specially instructed to do so, it is not the duty of the medical officer to attend cases of infectious disease. The main object of the appointment of a medical officer is to afford the Local Authority the aid of a properly qualified adviser, with regard to all sanitary questions on which professional advice is to be of service." With regard to the duties of the sanitary inspector he says (p. 13), "The duties of sanitary inspectors are laid down in general terms in the byelaws recommended by the Board." Let us now see what the Board's Byelaws say with regard to the county sanitary inspector's duties. These Byelaws are, of course, not compulsory on County Councils; but it may

be taken for granted that the Board will not sanction any other set of proposed byelaws which are not conceived in the breadth and spirit of their own model set.

1st Byelaw.—" The sanitary inspector shall, by inspection of the county, both systematically at certain periods and at intervals as occasion may require, keep himself informed of the sanitary condition thereof, particularly as regards drainage, water supply, and the evidence of nuisances." Under this byelaw extensive duties are contained and considerable knowledge presupposed. Take the specialties mentioned as coming under his immediate supervision:—

(1.) *Drainage.*—Here a wide and fruitful field of enquiry is at once open to him. Both the public and private drainage of many of the county districts are known to be deplorable. His inspection of private drainage will range from the sluggish quagmire of sewage which soaks into the foundation of the thatched " biggin " to the country mansion, whose ancient drain ramifies under the building and finally debouches upon a gigantic cesspool. In public drainage he will come across villages the sewage of which is run into the nearest field or plot of ground. This it is supposed to irrigate, but in reality the field has long since become so saturated and soured that the whilom porous soil is choked, and has no longer any power of absorbing and disinfecting the putrescent matter. These, and kindred problems in drainage, will face the inspector wherever he turns; and, besides being able to judge when a nuisance is created under the Act, he must be able to report and advise correctly regarding the best means both for dealing with the private and public nuisance. This involves a technical knowledge of every detail in house drainage and plumber work, and also an acquaintance with the best measures to be taken either by irrigation, filtration, precipitation, cellular chemical treatment, or by any combination of these various methods for the treatment of sewage.

(2.) *Water Supply.*—Under this heading a vast amount of work requires to be done. The shallow wells and sewage-impregnated burns and rivers, which throughout the country districts afford supplies for man and beast, are almost proverbial. The inspector must be able to distinguish between the wholesome, the suspicious, and the dangerous, and ought to be in a position to apply a ready test to samples brought under his notice. Besides this, he should acquaint himself with the nature of the impurities taken up in transit from the source to the storage reservoirs, from the storage centres themselves, and from the means employed in the general distribution of the water. He should be able to advise the Local Authority as to a suitable scheme for the supply of water to any district, as to its filtration and purification, and also be competent to give an opinion on the amount required for a certain inhabited area, leaving a suitable margin for prospective requirements.

(3.) *Evidences of Nuisances.*—Here we have a heading which covers a variety of subjects, ascending through infinite gradations from the earth-bottomed (rough dug) midden, with its stinking, insect-covered contents reeking in the sunlight, to the hidden and innocent-looking ventilating pipe, which is too often set by the thoughtless plumber between the chest of the pan or valve water closet and the soil pipe. The fullest practical knowledge is necessary here to enable the county inspector to investigate into the hidden causes of blood poisoning and disease.

2nd Byelaw.—"The sanitary inspector shall afford the County Council information and advice in all matters affecting the sanitary condition of the county; and shall see that all lawful instructions of the County Council and their medical officer are duly carried out."

By this byelaw the inspector is placed in a position with regard to the County Council similar to that of the medical officer, who by clause 3 and the byelaws relating to him has identical duty, and by Byelaw 5, must, when applied to by the sanitary inspector, "give advice and render assistance in any matter connected with the public health." The last clause of the byelaw must not, it seems to us, be read as implying that the county inspector is placed under the instructions of the medical officer. This would destroy his independence as a responsible and executive official, which position has always been jealously guarded and secured to him in Scotland. But when the medical adviser has reported to the council that such and such ought to be done, and after they have approved of his advice and homologated his recommendations, they *and* he together may instruct the county inspector. He, upon considering it "a lawful instruction," shall proceed to act upon it. It would be expedient, we think, to strike out the words "and their medical officer," as, if any instruction be necessary, the inspector would gather it from the minutes of Council, as he is required by Byelaw 10 to be present at every meeting of the Council.

3rd Byelaw.—"The sanitary inspector shall, when applied to by the medical officer of the county, or by the District Committee or medical officer, or sanitary inspector of any district in the county, give advice and render assistance in any matter connected with the public health."

This is equivalent to saying that the highest service must be at the call of the whole or every part of the county, and is the same as Byelaw 5 regulating the duties of the county medical officer.

4th Byelaw.—"On receiving information that any disease has become or threatens to become epidemic in the county or any part thereof, the sanitary inspector shall co-operate with the District Committee and their sanitary inspector in carrying out measures requisite for preventing the spread of the disease."

This byelaw puts the county inspector in immediate communication with the District Committee and their inspector when they mostly require them, and is precisely similar to Byelaw 6 for the county medical officer, who in like circumstances is to co-operate with District Committees and district medical officers, with the object of "taking measures for the prevention or mitigation of the disease." It will be noticed that the inspector and district men "shall carry out the requisite measures for preventing the *spread* of the *disease*." The requisite measures required may be manifold —(1) it may be the stoppage of infected milk; (2) it may be the forbidding the use of contaminated water; (3) it may be the compulsory closing of public schools; (4) it may be the compulsory shutting of an overfilled graveyard; (5) it may be the complete and instant cleansing of all privies and ashpits, and the universal lime-washing of them; (6) it must be the thorough disinfection of all infected dwellings, clothings, and utensils; (7) it must be the thorough isolation of the infected patient in the dwelling, or his removal to hospital; (8) in certain circumstances it must be the removal of a whole poor family to a Reception House; (9) in certain diseases, such as enteric fever and diphtheria, it ought to be a thorough examination of the drainage and condition of infected dwellings; (10) in persistent cases of typhus, surreptitious night inspections will be necessary in households where there is suspicion of overcrowding. These and other measures will at once suggest themselves to an intelligent inspector, as requiring earnest consideration in arresting the spread of diseases.

5th Byelaw.—"The sanitary inspector shall, when required by the County Council, from any District Committee of the county, advise proprietors and others of the sanitary condition of their premises, and as to any improvements which may be required therein."

This duty is one which, we doubt not, will be often imposed upon the county inspector. In such work his technical training in drainage, ventilation, general house and farm construction, will be in general requisition; and in its prosecution the services of a competent draughtsman to enlarge and elaborate his sketches will be almost essential. We think the Council will be saved a great deal of unnecessary correspondence, and consideration of the requisitions for this service, if such were deliberated upon by the inspector himself, who would only bring such requests before the Council as appeared to him unnecessary or uncalled for.

6th Byelaw.—"The sanitary inspector shall, when required, report as to any appeal to the County Council, from proceedings or orders of the District Committee." This is a most important byelaw. It places upon the shoulders of the inspector the full responsibility of advising upon disputed notices or instructions issuing from the officers of the District Committees. That appeals from proprietors to the County Councils will be largely taken advantage of goes without saying, and the inspector of the Council

will need all his technical training, legal knowledge, business capacity, and common sense in reporting fully and fairly upon the questions at issue between the contending parties. Knowledge and tact will in many cases obviate the final arbitrament of the court, and all who have experiences of the legal processes under the Public Health Act will value in the highest degree any interference which will settle differences and satisfy sanitary necessities apart from an appeal to the sheriff.

7th Byelaw.—"The sanitary inspector shall, when required, report on any capital works under the Public Health Acts to which the consent of the Standing Joint Committee is required under Sec. 18 (6) of the Local Government Act."

Here the business qualifications of the chief inspector will be mostly tried.

One of the early requirements of the counties will be the erection of suitable hospitals and disinfection stations. The acquirement of suitable ground, and the planning and estimating for these works and the requisite machinery must be supervised by him. In the designs and estimates for water supply and new drainage works he of course will have the assistance of the surveyor, but he ought to be able to grasp the general principles upon which such works are carried out, and report to his Council or to the Standing Joint Committee in a clear and comprehensive manner. It may be inferred from the byelaw that he will be charged with all estimates out of capital for such work, and he should be able to report also on the current expenses likely to be incurred in their working and maintenance. He must also acquaint himself with the speediest and most economical methods of modern disinfection and hospital organization. Machinery and steam now play such an important part in this field of sanitary work, that he cannot afford to be wanting in an exact knowledge of their uses and application.

8th Byelaw.—"The sanitary inspector shall make such reports and returns as may be called for by the County Council or the Board of Supervision; and shall observe and execute all lawful orders and instructions of the County Council or the Board of Supervision applicable to his office."

This byelaw may be passed with the observation that he must see to it that he has in his service clerks who are expert and correct with figures. They should also be men who can show readiness and clearness in penmanship, and one of them at least ought to be a good shorthand writer.

9th Byelaw.—"The sanitary inspector shall report to the County Council whenever it appears to him that the Public Health Acts have not been properly put in force within any district, or that any other matter affecting the public health of the district requires to be remedied, in order that the County Council may be enabled to decide whether a representation should be made to the Board

of Supervision on the matter, in terms of Sec. 53 (2) of the Local Government Act."

This is identical in terms with the 8th Byelaw for medical officers. It appears to be intended that the county medical officer and the county sanitary inspector shall conjoin as censors over the administration, or rather the mal-administration, of the district committees and their officers, and report upon any remissness of duty intentionally and persistently followed. From the extremely delicate nature of such a duty it may be inferred that the Board have seen it advisable to place upon the two chief officers the same responsibility. A careful consideration of the matter, however, may convince County Councils that what will amount to a very close scrutiny of all the facts (before such a course as reporting adversely upon the want of proper administration in any district is adopted) would involve *two officials* in much expenditure of effort and time. On the whole, we think the better course would be to place this unpleasant but necessary duty upon *one* of these officers. If the County Council, upon receiving any such report from *one* of its chief officials, desired, before intimating delinquency to the Board, to further elucidate the matter, it would then have the option of referring the subject to the other chief officer previous to taking the final step. This, we think, would be an improvement upon this byelaw. As the byelaws stand, no one of their chief officers would care to report without the promised support of the other.

10th Byelaw.—"The sanitary inspector shall keep a journal, in a form to be approved by the County Council, in which he shall enter his visits, inspections, and other proceedings, with notes of his observations and of any instructions he may give. He shall submit his journal to every meeting of the County Council, and shall produce it when required by the Board of Supervision or their inspecting officer."

The 10th Byelaw for medical officers is identical with this.

We have no hesitation in saying that these byelaws should be deleted. In the first place, such "journals" would consume a great deal of time in writing up. Secondly, they would never be read. Thirdly, they would contain a large amount of unimportant matter. And, fourthly, no real benefit could possibly be obtained from such daily diaries. We think it ought to be presumed that the chief officers of the County Council will be honestly busy day by day, and that a concise and clear report laid before the Council every month would fully satisfy that body as to the work and progress going on in health matters.

11th Byelaw.—"The sanitary inspector shall report to the County Council whenever it appears to him that it would be advisable that byelaws should be made under Sec. 57 of the Local Government Act for the prevention and suppression of nuisances not already punishable in a summary manner."

When one considers the number of offences against the public health which may at the present time pass unpunished, he cannot help being thankful that the powers contained in this byelaw are placed in the hands of the county inspector. To traverse the whole Act and show in detail the loopholes which exist for the escape of many offenders cannot be accomplished here. Sufficient for our present purpose to point to this most important provision in the Local Government Act. It is to be hoped that when such byelaws are suggested by the helpless inspector that the Central Board will heartily homologate the representations of the County Councils, and give legal effect to them. The intelligent and zealous inspector will not be long in seizing the opportunity thus presented.

12th Byelaw.—"The sanitary inspector shall annually prepare a report for the year ending 31st December, and shall transmit a copy of such report to the Board of Supervision and the County Council not later than the 31st March of the year immediately following that to which the report refers."

This is a most useful provision, and one which, in the course of time, and in the hands of earnest and intelligent inspectors, will do much to engraft upon the public mind of the country a true appreciation of the benefits conferred by sanitary enactments. It will also serve the important purpose of yearly calling attention to the faults and weaknesses in our present law, and we have no doubt will hasten on the time when the Legislature will feel bound to grant to Scotland a new Public Health Act, more in likeness than our present one is to the Acts enjoyed by the sister countries of England and Ireland. We observe that there is nothing in these byelaws suggesting supervision of this officer in the execution of work necessary under the "Sale of Food and Drugs Act;" the "Margarine Act;" the various "Dairies, Cowsheds, and Milkshops Orders, 1885;" nor the "Sale of Horse Flesh Act." It will be necessary for the County Councils to make some official responsible for carrying out these important enactments, and in our opinion it is matter for regret that the Central Board has not in these model byelaws made any distinct statement on the subject, further than to say that the medical officer shall advise the County Council with regard to them. The proper discharge of the duties under these enactments alone is onerous and irksome, and it may be well presumed that a salary which will fairly recompense an official for all his duties under the Public Health Act and the General Police Improvement Act, would not be sufficient emolument for undertaking the extra labour necessary to put these various Acts in force. Hitherto it has been the custom for the sanitary inspectors to be charged with this work, and we think it would be well, both in the interests of the officials themselves, the County Councils, and the ratepayers

generally, to have it clearly laid down in the byelaws what Acts of Parliament have to be put in execution and by whom.

Such a course would save heartburnings and grumblings in the future. It is true that the "burden which is well borne becomes light," but it is also true that the imposed, unexpected, and unpaid burden becomes heavy, and is not carefully carried.

Side by side with these model byelaws we have now seen the general outline of the county sanitary inspector's position and work. It is an honourable position, and noble though irksome work. Fighting through it all he will be called hard names. But obloquy must never engender obliquity. Straight on his course, through fair and foul weather, he—working hand in hand with the medical officer—must steer, until the districts and people committed to his care are many many miles nearer to the Hygeian shore than they are in 1890.

MICROBES IN AIR, WATER, SOILS, AND FOODS IN RELATION TO INFECTIVE DISEASES.

By T. G. NASMYTH, M.D., Cowdenbeath, Fife.

At last year's meeting of this Association in Inverness, I delivered a general address on the subject of Contagia, and from the encouragement my effort met with then I am induced to take up the subject again, but entering more into detail, with the object of putting before the general reader an epitome of the knowledge we possess of the life history of that low class of organisms which we now identify as closely allied to the idea of contagion.

A few years ago, one writing on the subject I have selected would, of necessity, have had to enter into the wide sea of controversy regarding the origin of these organisms in the various media they occur in, but at this time this subject can be avoided for various reasons, as we are now about to discuss some interesting features of the life history of these organisms, without entering into the question of their origin. The simple fact is they exist, and their existence is associated with most important phenomena in the domains of Chemistry, Physiology, and Pathology, and these associations cannot be denied even by those who believe in the theory of spontaneous generation, or by those who believe in the *de novo* origin of infectious diseases.

I do not intend discussing the origin of germs, any more than I wish to discuss the descent of man, or the descent of any form of plant or animal life. If, however, proof of the potent agency of micro-organisms were needed in producing, for instance, putrefaction, one has at hand proof which should convert the greatest sceptic; for no more extensive experimental proof on a large practical scale was ever given to any scientific investigation than by the everyday experience of the use of preserved foods and vegetables. Millions of tins of fruits, vegetables, and meats are annually consumed, after preservation for weeks, months or

years, with perfect success, and this depending on, *first, the recognition of the causes of putrefactions; and secondly, the adoption of scientific principles for destroying these causes.*

You are aware of the processes carried out for securing the second condition, viz., boiling the fruits or meats, so as to insure destruction of any organisms they are affected by, and sealing the tins to prevent the ingress of fresh organisms. Here we have examples of disinfection or sterilisation. I show you two tins of meats: one has been opened for a week, and you can see and smell the result, the other has only been opened to-day and you can detect nothing wrong, but in a week this one will be as bad as the other. Another proof, on a very large scale also, is the process of preserving all forms of animal or vegetable matter by refrigeration, that is to say, lowering the temperature sufficient to restrain at least the action of putrefactive organisms. In the laboratory it is not necessary to seal up hermetically the various animal or vegetable matters we wish to protect from the agency of these organisms; it is only necessary to boil the material, and then filter the air passing into the vessels in which the materials are preserved. In the tubes I show you, the material has been for years, the air passes freely in and out, with the varying pressure and temperature of the atmosphere, and no change in the substance has resulted, simply because the air has been filtered of its contained living particles.

It was a great day for Hygiene, for Preventive Medicine, when Schwann clearly established the connection between putrefaction and something that could be seen under the microscope, a something that had shape, and form, and existence,—something *particulate.* No foe strikes greater terror than an unseen one, even if the darts he throws are feeble; but when the foe is both unseen, and the darts are deadly, the terror is redoubled, and the attacked have no defence. Such was the position of our "healing" art prior to Schwann, Cagniard Latour, Pasteur, Lister, Koch, and their distinguished followers, at least as far as those diseases which are amenable to the art of the sanitarian are concerned, for infective diseases were looked on with awe and superstitious dread, as mysterious influences unknowable as to their origin, and equally so as to the measures that were to be adopted for their prevention. Tyndall, writing on this subject, says, "Of that class of diseases now known to be caused by 'particles,' consider the woes which these wafted particles, during historic and pre-historic times, have inflicted on mankind; consider the loss of life in hospitals from putrefying wounds; consider the slaughter which has hitherto followed that of the battle-field, when those bacterial destroyers are let loose, often producing a mortality far greater than that of the battle itself." And further on he remarks regarding those unseen agencies, "We have been scourged by invisible thongs, attacked from impenetrable ambus-

cades, and it is only to-day that the light of science is being let in upon the murderous dominion of our foes."

The remarks that I have already made are only preliminary, but necessary to give a clear idea of the state of preventive medicine prior to the dawn of a new era, through the development of the knowledge of living particles in relation to fermentations and putrefaction, and the application of this knowledge to medical and surgical science. Before entering into the subject proper of this paper, it must be noted that those living particles, about which we have been incidentally speaking, are known by various designations, but meaning the same. Thus, we speak of Microbes, Micro-organisms, Micro-parasites, Micro-phytes, Lower Fungi, Fission Fungi, Germs, Bacteria, &c.; and again, biologists have different classifications, but this does not concern us here.

In this paper it is impossible even to glance at all the various relationships of microbes, however interesting the subject might be, and however necessary it is to understand fully the important role these organisms play in the economy of nature; but it will be necessary to give a brief synopsis of their general features, so that their action as disease-producing agents (pathogenic) may be more readily understood.

Role of Micro-Organisms.

We have spoken of the work of Schwann in reference to Fermentation, and this subject is one so closely bound up with the whole theory and history of microbe action, that a brief reference to fermentation is necessary. From time beyond history brewers have prepared from malted barley a substance called "wort," and by the addition of a little yeast, a substance is produced, dear to man in all times, called alcohol. Without entering into the subject fully, for this would be tedious, it is sufficient to note that in this process of alcoholic fermentation we have the wort—containing, amongst other things, sugar—changed by the agency of yeast into alcohol; and this yeast is a living plant, the Torulae Cerevisiae. In one of the tubes I show you, you have an example of the Torulae, in this case a pink one. Alcohol, if allowed to stand, is itself subject to a change. Another organism attacks it, and we have instead a substance, not so dear to man, called vinegar; the ferment in this case is the Mycorderma Aceti. These are two examples of fermentations; but there are others, in each case due to specific organised ferments; thus, in milk, we have the Lactic Acid fermentation, Butyric, Urea fermentation, and so on. Besides the specific substances produced, we have the evolution of gases.

Putrefaction.

It requires no strict chemical definition of this process to convey the meaning of the term, for the evidences of decay and putrefaction are everywhere, and are apparent to the senses of smell and sight. In a scientific sense we understand this process to mean the rapid and intense decomposition of nitrogenous, and chiefly albuminous, substances by micro-organisms, with the evolution of foul-smelling gases. It would be beyond the scope of this paper even to enumerate the various products of putrefaction, but briefly to mention an important few will be useful. The first things that form in albuminous substances are peptones, then leucine, tyrosine, and a great many gases—Carbonic Acid, Hydrogen, Nitrogen, Sulphuretted Hydrogen, Ammonia; and such substances as Indol, Skatol, Phenol; and finally, what are called "Ptomaines."

These products are specially selected from an extensive list, from their direct relationship to practical hygiene, being at all times present when we have decomposing animal or vegetable matters. Some of these products are deadly in their effects, and they all lead to what is called a "low state of vitality," about which there will be something said farther on. A fuller reference must be made to Ptomaines, because modern research, by combined chemical and biological methods, points to the conclusion that the injurious effects of micro-organisms in tissues and fluids in the animal organisms are due to these, and that those injurious effects, from the ingestion of unsound foods, are due to these poisonous alkaloids called Ptomaines. Amongst the poisonous—for some are non-poisonous—may be mentioned Pepto-toxine, Neurin, Muscarin. A Ptomaine has been isolated from the bacilli of Typhoid Fever, which produced toxic effects on animals experimented on. Those substances called ptomaines produce the pernicious effects due to the entrance and growth of microbes into wounds, and the surgeon endeavours to combat this by preventing the organisms gaining entrance to wounds, as far as possible, and by the use of antiseptics to destroy those organisms which may have gained entrance. *The next more advanced stage will be the use of agents which will neutralise the ptomaines which have been absorbed into the system.*

Amongst other actions of microbes have simply to be mentioned the formation of pigments, the process of putrefaction, the breaking down of tissues and rendering them suitable for the food of higher plants containing Chlorophyll. From what I have already stated, it will be seen that these lowly organisms are of widespread occurrence in nature. Wherever we have sufficient nutritive material, moisture, and heat, they abound and develop. On the human body they are constantly present—in the mouth, nose, eyes, alimentary canal; and this time seems a favourable

one for at once stating that it by no means follows that the presence of micro-organisms necessarily implies any evil consequences, or of even any importance at all. While it has been sufficiently proved that several diseases of a most important order are actually caused by micro-organisms, by far the greater number of these micro-organisms are not at all hurtful, while many are of direct benefit to the human race.

The mere finding of micro-organisms in tissues is not sufficient proof of their causal relationship to any disease present, and the observer must carefully keep in mind Koch's postulates, which are :—

1. The micro-organisms must be found in the blood, lymph, or tissues of man or animal suffering from, or dead of the disease.

2. The micro-organisms must be isolated from the blood, lymph, or tissues, and cultivated in suitable media, *i. e.*, outside the human body. These pure cultivations must be carried on through successive generations of the organism.

3. A pure cultivation thus obtained must, when introduced into the body of a healthy animal, produce the disease in question.

4. Lastly, in the inoculated animal the same micro-organism must again be found.

By careful attention to every point in these rules alone can erroneous ideas be prevented as to the causal relationship of microbes to diseases. At this time I do not intend dealing with the direct relationship of micro-organisms to disease, but to enter into some features of great sanitary importance, connected with the distribution of microbic life in air, water, food, soils, and in clothing, and to finish this paper by pointing out how immunity is secured to mankind against the ravages of disease-producing microbes by their own self-destructive actions and by the resistance, natural and artificial, of their hosts.

Micro-Organisms in Air.

An attempt has been made, by estimating the number of micro-organisms in air, to form definite opinions regarding the organic impurity present, and for this purpose measured quantities of air are drawn through glass cylinders provided with the necessary food for microbic life, the organisms are deposited on the nutrient surface, and in a few days grow and develop, and the number of colonies can be counted. The most useful method for this purpose is Hesse's [tubes shown and process explained]. The actual relationship of number of colonies and quantity of organic impurity, however, depends on various other considerations, which must be taken into account, such as temperature, moisture, and air currents. By the elaborate experiments at Dundee, carried out by Carnelley, Haldane, and Anderson, a great deal of information has been gained, for not

only did they find that in the air of the one, two, and three-roomed house, was there a direct relationship between numbers of micro-organisms and organic impurity, but that in schools mechanically ventilated, as distinguished from those naturally ventilated, the proportion of microbes in the former to those in the latter condition was about 1 to 9. In schools, if the air was still, the numbers were small, while movements and stamping of the feet increased the numbers, this being due to disturbance of microbes, which had gravitated to the floor. For full particulars about these investigations, this valuable paper should be consulted (*Transactions of the Royal Society*, 1886). In sewers Haldane and Carnelley found few microbes, and the explanation of this is, they gravitate into the sewage.

From my own experiments on the air of coal mines, I found that many varieties of microbes were to be found, but not always in a proportion indicating close relationship to amount of organic impurity present.*

Nägeli has shown that strong currents are unable to detach bacteria from moist surfaces; and only when there is a spurting up of a fluid by waves, or by agitation of water, such as by a mill-wheel (or the paddles of a steamer), that particles of water with contained organisms can be carried by currents of air for short distances. This is of great consequence, from the fact that the bacillus of cholera is destroyed by drying, and cannot readily be carried by air, except in the conditions above stated, and further explains why cholera rarely passes over sandy deserts. The seasonal prevalence of typhoid may be explained in part by its bacillus becoming dry and volatile, is detached from liquids and moist surfaces, and is conveyed by aerial currents. Isolated cases of typhoid, without any apparent defective sanitary conditions, may, and do, undoubtedly occur from this cause. In a paper in the *Edinburgh Medical Journal* many years ago, I pointed out this as an important factor in the occurrence of isolated cases.

Micro-Organisms in Water.

The numbers of colonies on "plate cultivations," from a measured quantity of water, have a most direct relationship to the amount of organic impurity present, but subject to a great many important determining factors—such as the length of time the water has been stored, the temperature of the water, and the air. From my own experiments on an extensive scale, for instance in Loch Katrine water, the number of colonies in a fixed quantity varied only slightly, and never exceeded more than 27; while in a water associated with an outbreak of

* *British Medical Journal; Transactions* of Laboratory of Royal College of Surgeons, Edinburgh, vol. i.

enteric fever, the colonies were so numerous that they could not be counted. And by using sterilized distilled water, and adding to two samples, in one case 1 gr. of organic impurity, and to the other 2 grs., I got respectively 20 and 42 colonies.

At this time I wish, however, to consider the subject of microbes in water from their relationship to actual disease production, and to point out the conditions acting for and against this occurrence. Epidemics of cholera and typhoid fever have been repeatedly traced to polluted water supplies. The question before us now is—Do the various biological conditions of the micro-organisms concerned with these diseases agree with these well known facts, we might call them laws? It has been proved by numerous experiments that microbes are to be found in water, however pure, and the more organic impurity the greater number of organisms will be found. We must admit, as a premise, that water is a suitable medium for the growth of ordinary microbes, and we will now discuss the subject of actual disease-producing forms.

The question of pathogenic organisms and water has been the subject of very extensive laboratory experiments; and it may at once be stated that these do not exactly represent the conditions found existing in nature, and must be received with some reserve. Frankland's experiments show that the bacillus anthracis perished in a few days, but the spores retained their vitality for months.

The typhoid bacillus retains its vitality for ten days, even in distilled water.

The cholera bacillus multiplied enormously in sewage, while in filtered or deep well water little or no multiplication took place.

Tubercle bacilli, from other experiments, have been found living after six or seven weeks in running water.

The cholera bacillus requires some further notice from its important relationship to water as its vehicle. It has been found that in waters which are stagnant, and where there is a local accumulation of nutrient materials, or floating solid matters, multiplication of the bacilli occur. In a tank in India, polluted with fæcal matter, Koch found the bacilli present in enormous numbers, and cholera was prevalent at this place. We may accept, therefore, as an assured fact that in waters polluted with fæcal matter the bacilli of cholera and typhoid fever thrive; and, further, considering the fact that the dejecta in these diseases contain the actual contagion of these diseases, the connection between outbreaks of these and polluted waters, and the biological conditions of their causal microbes, agree in every particular. It must be borne in mind that water, however much polluted, which we may call x, will never develop cholera without the specific contagion y, but $x + y =$ cholera. Im-

munity, however, is derived from many causes, such as filtration of the water or sewage, with y, through soils (excessive pumping of wells diminishes the micro-organisms), and the growth of other organisms in the water with y lead to its destruction.

While microbes gain access to wells easily by surface contaminations, and by drains, gutters, &c., if they have to pass through a considerable length of soil the risk of their gaining entrance is very much lessened. Their progress is facilitated by porosity of the soil, and by the underground currents of subsoil water. Further points of importance in connection with bacteria in soil in relation to water supplies will be discussed under Soils.

Microbes in Soils.

Soils have been believed, since Pettenkoffer's deductions, to have an important influence in the production of infectious diseases. The connection, proved by statistics, of the relation between mortality of typhoid fever and variations of the level of the ground water, led Pettenkoffer to believe that the soil had a marked causal relationship to the production, not only of typhoid fever, but cholera.

Pettenkoffer's "Law of the Subsoil Water," as it has been called, has been used differently from what he intended, and it is well to ascertain what he did actually mean; and in a paper in 1880, he says:—"In my view the level of the subsoil water reveals nothing more than this—viz., the limits of a certain degree of humidity in a porous stratum of soil, or the limits within which the pores are kept constantly full of water, and all the air driven out of them. Between that degree of humidity and absolute dryness of the porous stratum, there are all those gradations where the pores are filled in part with air and in part with water in varying proportions, which we include all together under the terms 'moist' or 'wet.' The point at which the pores are completely closed by water is one that may be observed with ease and certainty; and I have therefore chosen the level of the subsoil water merely as an easily seen guage and index of certain states of humidity in the stratum of porous and permeable soil which overlies the subsoil water; an index, namely, of the fluctuations of the humidity within a given period, and of the time that any one degree has lasted. Whether that index is a few feet nearer to, or farther from the surface does not affect the value of its revelations. For the value of the index lies in this, that it declares the changes in the humidity of the overlying strata by means of the natural effect of these changes. The fluctuations in the level of the subsoil water have a meaning for etiology, only because they are traced back to those primary influences by which air and water are made to share, in varying

proportion, the possession of the pores of an impregnated soil. Beyond that they have no significance."

We have referred fully to these well known views, as they are of importance in relation to the subject of microbes in soils. Pettenkoffer further attributed the soil to have a definite and peculiar influence on infective germs, but modern research has not confirmed that view.

Soils have been arranged into three zones:—

1. A superficial or evaporating zone. It is a receptacle for all pollution, microbes, ferments, &c.

2. Intermediate zone, costantly humid.

3. A compact zone. The subterranean water acts on this by capillary attraction.

The superficial zone is the one most likely to act as the breeding ground for organisms, whether harmless or pathogenic, as there the necessary food is met with for their growth. If we have fæcal matter, then, if the cholera or typhoid bacillus be introduced, under other favourable circumstances of temperature and moisture, it will grow and develop. Those favouring conditions are very much what Pettenkoffer insisted on, only without giving to the soil any specific influence, which he believed necessary, there must be simply a porous, permeable soil, neither too wet nor too dry, sufficient pabulum, a suitable temperature, and the specific organism of an infectious disease introduced to give to the soil all the influence it can exert in the production of infectious diseases.

Murchison's views as to the origin of enteric fever are totally different from these, as he held that it might arise from decomposition of fæcal, and even of organic matter. And while he admitted that it was communicable, he believed that this was due to the decomposition of the excreta after their discharge. Modern research has shown that there is a specific microbe needed for the production of the disease, and without this neither water, nor soils polluted by organic or fæcal matters, will communicate the disease to man. I might further extend this and say that none of the influences ordinarily held to be associated with typhoid, such as foul cesspools, untrapped drains, unventilated sewers, or all the array of conditions called insanitary, will produce typhoid, without the specific cause. These conditions undoubtedly have a marked *predisposing* effect, and this will be referred to farther on.

If these conditions did of themselves *generate* typhoid, how is it to be explained that the disease is ever absent at all from every hamlet and village in Scotland, with their well-known insanitary conditions?

That micro-organisms exist in the soil can be proved by the very easiest methods for cultivation of organisms. Infusions made from manured soils, even although diluted 100 times, still

contain thousands in every drop; but the greatest interest is necessarily attached to the finding of disease-producing forms, and of these the bacillus of malignant œdema, and of infective tetanus are frequently found.

The formation of nitrates and carbonic acid by the action of microbes have also to be mentioned.

Immunity from Bacteria in Soils.

In the laboratory, by providing a specially prepared food suitable for the needs of each individual case, and by careful regulation of the temperature and moisture of the air, many disease-producing organisms can be cultivated: but when an individual organism, say, for example, the cholera bacillus, gains entrance to the soil, it by no means follows that it will meet with the necessary conditions of food, moisture and temperature. If the ground were polluted with fæcal matter, then this is a suitable medium, but the temperature must be between 60° and 70° F., or if the temperature be so high that drying of the bacillus takes place, this is fatal; if the soil is acid, this is fatal, nor can it grow in a water-logged soil. Another powerful antagonistic action is the growth of the various organisms of decomposition (Saprophytes). It is one of the many wise dispensations of providence that our enemies can only attack us after we have, with the most perverse ingenuity, broken all the laws which regulate health, and a visitation of cholera is a sanitary reformer needed now and again to put matters right.

Although microbes may not develop and multiply in the soil for want of the necessary favouring conditions, it must not be forgotten that they may be latent for long periods, especially in the spore forms. Thus the anthrax bacilli, which form spores, may remain latent for a very long period, probably years, and finally develop when the necessary conditions are provided. Admitting that disease-producing organisms are to be found in soils, the next question, and one of much importance, is,

How they gain Admission into the Body.

1. *Action of Winds.* That aerial communication in many diseases is common cannot for a moment be doubted, but when the organism is in the soil this method of transmission must be difficult. We have, at a former period, referred to a superficial evaporating zone of soil which contains organisms in abundance, and when, under the heat of summer, drying takes place, it is not difficult to imagine the bacilli of typhoid becoming dry and detached, floating away with air currents, and falling into water supplies, milk, &c., or being taken directly into the mouth and then swallowed. Capillary action, upward air currents, and

worms, may raise organisms from the lower zones to the higher, and bring them under the influences to which the upper zone is liable. The experiments of Frankland, showing the diminution of organisms in water by filtration, must be kept in view.

2. *Action of Water.* It has not been found that bacteria can travel far through soils, even by water-currents, but where there are pores and openings in the soil they undoubtedly can pass to the subsoil water, and thus into water supplies. Water mains, when leaking, and during intermissions of flow, may, and do undoubtedly, draw in specific contagia. The incidents of the Caterham outbreak of enteric fever point to the pollution of the subsoil water and the transmission of the typhoid bacilli a considerable distance through soil.

3. *By the products of the Soil.* Vegetables, fruit, and flowers may be the vehicles by which the contagion is carried from the soil to the person attacked, and this means of communication should be kept in view, especially in connection with cholera.

4. *Flies and Insects* may be the intermediate agency.

5. *Digging and turning up of the soil* renders it liable specially to the conditions under number one and four headings.

6. One important means, especially in the case of children, has to be noted—viz., by means of the fingers and hands children frequently play with soil, fouling their hands, and it is easy to understand how they may pass the specific organism of typhoid from the soil into their mouth. I had a case, not long ago, attributed to this.

In concluding my observations on soil and bacteria a short reference must be made to Emmerich's observations on the excessive amount of micro-organisms in the damping material under floors of dwelling houses. In a prison where there had been an epidemic of pneumonia, the bacteria of this disease were found in enormous numbers in the damping material under the floors. This soil under the floors must not be neglected when looking for possible factors in the production of infectious diseases.

Micro-Organisms in Foods.

The references we have already made to the role which microbes have in causing fermentation and putrefaction in various animal and vegetable substances, and further, that various microbes are found in large quantities in air, water, and soils, prepare us for believing, *à priori*, that they will be found in the various articles used for human food. The literature bearing on the subject is so extensive that a selection of certain articles of food, in connection with disease-producing microbes, must alone be referred to.

Milk is the typical food for purposes of illustration, and it occupies the unique position of being a typical nutrient medium for microbes, as well as being the typical food for infants.

I need not enter into any discussion regarding milk as a suitable food for microbes, further than state that Lister, in a paper on Lactic Fermentation, states that milk serves as a food for nearly all organisms. Woodhead, Klein, Cruickshank, and Koch, all refer in their works to milk as a good fluid medium for cultures. It, however, requires careful sterilization to destroy organisms that gain entrance from the time it leaves the cow (as well as before, in some cases).

In speaking of fermentation it was mentioned that the lactic acid fermentation was produced in milk by its milk-sugar being converted into lactic acid, and the milk becomes sour. Lister isolated a special organism, the cause of these changes; but subsequent experience does not limit these to one, but as many as fifteen varieties are believed to be able to produce the lactic fermentation.

Other well known fermentations in milk are the butyric, and the formation of "blue milk."

These are mentioned as examples, showing that milk is a suitable medium for the growth of ordinary microbes, but of more importance to us as sanitarians is the question of the suitability of milk as a medium for the growth of disease-producing microbes. Long before it was known that tuberculosis was due to a microbe, it was known that calves could be infected by suckling cows, the subjects of this disease; but the discovery of the bacillus in causal relationship to tuberculosis, and the fact that tubercle bacilli are to be found in the milk of tuberculous cows, has raised the subject to one of the first importance, from the enormous prevalence of tubercular diseases in man and the domestic animals, and the large and distressing mortality as a consequence. Bang, of Copenhagen, has further shown that the bacilli may be found in cream, butter-milk, and butter. I need not raise the question at this time whether it is necessary for the presence of bacilli in the milk, that the udder should be affected; late experiments by Dr. Ernst in America seem to show that this is not necessary, but if the animal is affected with tubercle in any organ, the milk may contain the bacilli. There is another means of infection from the cow, by the discharges from its nose or mouth, containing bacilli, becoming dry and volatile, floating through the air, and into the milk, or even into the lungs of human beings. This is highly possible, as dried tubercular matter has been found to be infective after 186 days. It is scarcely necessary to add that the bacilli are found in the flesh and organs of the animals affected; and flesh, unless thoroughly cooked, may convey the contagion to the human being.

Scarlet Fever.—The extensive and apparently conclusive experiments and observations of Klein point to a special micrococcus as the cause of scarlet fever; and, further, and of the utmost

importance to preventive medicine, that this organism is not only capable of being carried by milk, but that it is found in cows suffering from a peculiar eruption on the teats and udders. The conclusions deduced from the investigations can be put only shortly, and as given by the Medical Officer of the Local Government Board :—

1. Certain micro-organisms (micrococci) in the organs and tissues of certain cows, and in the discharges from their teats.
2. Cultivation of these micrococci.
3. Inoculation of calves from these sub-cultures, or by the material in the cows, produced a disease corresponding to that found in the cows, and to scarlet fever.
4. Micrococci identical to those found in the cows were found in the heart's blood of the inoculated calves.
5. The same organisms are found in the blood of Scarlet Fever patients.

The subject is too voluminous to be entered into here, and this brief epitome of a vastly important series of investigations must be accepted.

Typhoid Fever.—Now known to be caused by a definite organism which can be grown in milk. The bacillus forms spores, which retain their vitality for a long time; in a dry state, according to Gaffky, for three months.

Cholera, caused by the well known organism, the Comma Bacillus. This organism has been referred to already in reference to water and soils, and at this time I have simply to state that an outbreak was traced by Dr. Simpson, the Medical Officer of Health for Calcutta, to milk contaminated with the specific organism of cholera. In this case a ship's crew was affected. Of 14 who did not drink the milk, all escaped. Of 10 who drank the milk, 9 sickened; 5 with diarrhœa and 4 with fatal cholera; and the one who escaped only had a "thimbleful." The milk was proved to have been polluted with water in which cholera excreta had gained admission.

Certain so-called preservatives for milk—soda, lime, and others —counteract the acidity due to lactic acid fermentation, but have an injurious action in rendering the milk alkaline, and thus more favourable for the growth of pathogenic organisms. Experiments carried on by Drs. Lazarus and Ritter at the Hygienic Institute of Breslau, showed that in milk carefully sterilized pathogenic organisms grew well. In non-sterilized milk, the acidity soon destroyed the Comma Bacillus (Cholera). After milk has been sterilized for dietetic purposes, the flasks in which it is contained should be plugged with sterilized wool.

Of great importance, from the excessive mortality, are the digestive disturbances of bottle-fed infants, and due to the decomposition of milk in the india-rubber tubes by microbes. The shorter the tube, and the cleaner it is kept, the safer; but it is

impossible to sterilize an india-rubber tube by mere brushing and washing. Short glass tubes are to be preferred, from the possibility of cleaning and disinfecting them by boiling. Tyrotoxine, a poisonous alkaloid, has been found in fermenting milk. It is not the time to refer to the numerous epidemics on record, of Scarlet and Typhoid Fevers especially, being traceable to milk acting as the vehicle of communication, further than to say, that experimental cultivation of the specific organisms of these diseases are entirely corroborative of this connection. Time does not permit discussing at any length the occurrence of various microbes in other articles of food. The Typhoid and Cholera Bacilli grow on dead vegetable matter, such as potatoes, and in actual laboratory experiments potatoes are used for cultivating media. The Tubercle Bacilli, of course, are found in various tissues and organs of animals and man. The Bacilli of Anthrax are found in the blood of animals, and affect man when introduced, producing Malignant Pustule and Woolsorters' disease.

Outbreaks of fatal diseases have frequently been traced to the ingestion of meats which had been acted on by certain organisms, such as occurred at Welbeck in 1880, and at Nottingham in 1881, and investigated by Klein.

The dangerous or unpleasant effects which are caused by the ingestion of various kinds of fish, especially shell-fish, are probably due to the formation of poisonous alkaloids, due to microbes. Thus we hear of outbreaks of disease from eating mussels, oysters, and other molluscs, and often attributed to poisoning of these by sewage. There are probably organisms in sewage which have the effect of producing dangerous compounds in oysters and other shell-fish. Then there are some kinds of fish which, if used in the condition called "high," produce most dangerous symptoms, and are probably due to some alkaloidal poison.

Microbes in Clothing.

The presence of microbes in clothes must just be mentioned, but of very great importance, from liability of specific contagion being thus conveyed, and to emphasize the necessity of strict disinfection of such articles after having been worn by infected persons.

Bacterial Immunity.

The question, What are the conditions which give us immunity from the swarms of bacterial life which surround us on every side? is one of the greatest importance, and concerns the general public fully more than the methods and observations carried on in many laboratories in many countries, which have proved the association of these organisms with the production of disease.

In the first place, it must be carefully borne in mind that of

the clouds that encompass us, only a small proportion, as far at least as modern research shows, are endowed with disease-producing functions; and for the action of those that are pathogenic, a great many circumstances must co-exist. The bacteria of disease are selective in their choice of breeding ground. Thus, the microbe of Enteric seeks certain glands in the intestine; of Diphtheria, the mucous membrane of the throat specially; of Erysipelas, the skin; Cholera, the intestinal canal, and so on with the others; and failing to meet these organs or tissues, they will not harm the individual. Besides this selective action, there must be a prepared condition of the selected parts, as the healthy tissues and glands of the body have an antagonistic action. Metschnikoff's experiments show that a battle takes place between bacteria and leucocytes, and that the former are taken up and digested by the latter. The gastric juice can destroy certain pathogenic microbes.

There must be a condition either of local or general "low vitality," or of both combined. If we have been drinking polluted water, or eating unripe fruit, or in any way interfering with the normal performance of digestion and alimentation, we render ourselves liable to cholera during its prevalence, and to Typhoid at all times. If we have been breathing air polluted with the emanations of decomposing organic matter a low state of health is induced, and a weakened mucous membrane, which the microbe of diphtheria attacks and overcomes.

When referring to bacteria in various media, the conditions of growth were pointed out, and the absence of some or all of these conditions is of the utmost importance in securing immunity from their attack, and from the general prevalence of epidemic diseases.

Space forbids more than mere reference to the immunity due to vaccination and inoculation, depending on the development of a mild form of a particular disease from organisms "attenuated," artificially or naturally. The action of drugs on microbes in the tissues and fluids of the body must also be noted. The action of mercury, iodide of potash, quinine, &c., in controlling certain diseases, are, without doubt, due to their antiseptic and disinfectant actions.

In conclusion, the greatest immunity which the Sanitarian can promise comes from attention to the cardinal rules of Hygiene—Pure Air, Water, Food, Clothes, and Dwellings.

ADULTERATION OF FOOD.

By Dr. EBEN. DUNCAN,

Professor of Medical Jurisprudence, Anderson's College Medical School, Glasgow, and Physician to the Victoria Infirmary.

The adulteration of food is a wide subject, and so great is the diligence and ingenuity with which the fraudulent trader pursues his craft, that new forms of falsification are daily being adopted, to the great detriment of the public health. In this paper I shall confine myself to the consideration of two cases of food adulteration which have come under my own observation—one of them a milk adulteration, interesting from the novelty and cleverness of the fraud; the other, an adulteration of preserved peas, interesting from the fact that it is extremely common, and is at the present time the subject of considerable attention on the part of the authorities.

The first case is one of milk adulteration.

My attention was attracted one morning to a tumblerful of milk which had been left standing for some hours on my side-board, having been bought for consumption in my family. I noticed that in this milk there was a layer of thick yellow fluid, exactly like cream, at the bottom of the tumbler. As cream usually rises to the top of milk, the strange behaviour of this yellow matter seemed to me to demand investigation. I therefore subjected the milk to chemical analysis in the laboratory of my friend, Professor Milne, with his kind assistance. We found that the specific gravity was that of a normal specimen of good unskimmed milk. The fat reached the abnormally high figure of 7 per cent (a normal rich milk usually gives about 5 per cent as a maximum). The ash was also normal in amount, but the casein and sugar of milk were deficient in quantity. On examining the ash it was found to give the characteristic reactions of borax. The yellow colouring matter in the bottom of the tumbler had the characters of annatto (the substance with which butter is usually coloured.) Putting all the facts together, we came to the

conclusion that this particular milk was a mixture of 70 per cent of milk with 30 per cent of water. To give this diluted milk the appearance and taste of a rich milk, an emulsion of fat and annatto, made with borax, had been shaken up with it. We estimated that this compound could be sold at a very handsome profit. The 30 per cent of added water more than compensated the milk manufacturer for the cost of the adulterating ingredients. Anything short of a complete analysis would fail to discover a fraud of this kind. I am very doubtful whether any chemist employed by a Local Authority, at a fee of 10s. 6d., would expend the time and trouble needed to detect such a form of adulteration. In such a case the question arises as to whether the fat, borax, and annatto added to this milk would prove injurious to the health of persons partaking of it. If pure water and fresh fat were used these substances could not injure the health. The amount of borax was very small in proportion. It would improve the keeping qualities of the milk (prevent it from turning sour in warm weather), and would not injure health. But there is another aspect of the question. Milk is the staple food of the large class of bottle-fed infants, and as it is found unadulterated, it contains in proper proportion for the wants of the body the various chemical elements which are required for its maintenance in health and its growth. A milk like this containing fat in superabundance, but deficient in a due proportion in all the other nutritive ingredients, must in time prove injurious to the health of infants fed upon it. The fatty tissues of these infants would be overfed, while their muscular tissues would suffer from the proportionate diminution in the albuminous matters of the milk. Their bony tissues would suffer from the diminution in the due proportion of the mineral ingredients, and their nervous system from the diminution of the phosphoric acid. As a matter of fact, physicians find in the analogous case of preserved milks, which contain an undue proportion of hydro-carbon in the shape of sugar, that bottle-fed babies who live wholly upon such milks, although they may look fat and vigorous, stand illness very badly. They often succumb to illnesses from which children fed on more wholesome diet recover easily. I therefore hold that every kind and degree of adulteration of milk, which is the standard food of the infantile community, should be punished as severely as the law will permit. The addition of water to milk has too often been looked upon as a venial offence, and punished by a trifling fine. This encourages the offender, and leads to continual attempts on the part of dishonest dairymen to evade the law. If severe penalties could be inflicted, and if the law were amended to permit of a few fraudulent dairymen being imprisoned, without the option of a fine, a stop might be put to this nefarious practice of milk adulteration, a practice which, in my opinion, does very

serious damage to the health of the infant community in this country.

The second case to which I wish now to direct your attention is the case of the adulteration of preserved vegetables by sulphate of copper.

A few weeks ago I was asked by our Secretary, Mr. Stobo, to give evidence in the prosecution of a grocer for selling preserved green peas, which were proven to contain about 1½ grains of sulphate of copper in each pound tin. My connection with this case has led me to inquire into the present practice of traders in such commodities as green coloured preserved peas and pickles. I find that the great bulk of the trade is in the hands of French merchants, who send very large quantities to this country, their goods being sold in every large grocer's shop in the kingdom. I am credibly informed by wholesale and retail grocers that all these green-tinted preserved vegetables are treated with sulphate of copper. In a report on this subject to the French health authorities, dated 8th February, 1877, M. Pasteur states that out of 18 samples of tinned foods sent to him for analysis, he selected 14 indiscriminately and found copper in 10. He stated that anybody with a little practice could tell if a food were adulterated with copper, *e. g.*, in the case of tinned peas by *simple inspection.* "Whenever tinned peas show the natural green tint of fresh peas, you can be sure they contain copper; if the tint is yellowish and unmingled with green, they do not contain copper." He does not believe that any process of green colouration exists without the use of copper. He believes that if copper exists in the fluid in which the peas lie, that it "fixes itself in the insoluble condition in the solid matter of the pea, and notably in the leguminous portion, under the external cortical layer."

The Glasgow grocers whom I have consulted also assert that no other method of preserving the colour of these vegetables has been found to be sufficiently lasting. Some years ago a firm of French traders tried to colour their preserved peas with chlorophyll, but a grocer who tried peas treated by this method found that either on delivery in this country, or in a very short time thereafter, the whole of the colouring matter (chlorophyll) had separated from the peas and was found in the fluid matter in the tin. This fact of the separation of the chlorophyll is not surprising, when we consider that chlorophyll is the natural colouring matter of the pea, and is shed more or less in all preserved vegetables. As the public insist on having their preserved peas with the green tinge, and will use no others, my informant was compelled to go back to the copper-tinted tins and bottles as the only kind he was acquainted with that would keep their colour. Another grocer, who does a very high class business in Glasgow, informed me that he was quite aware that the preserved peas he sold were treated with copper, but he affirmed that it was impos-

sible to get peas to keep properly without such treatment, and that in his experience, fine green peas which were not so treated could not be got to preserve their form, but speedily became converted into pulp. He also said that his customers would not take preserved peas unless they had the delicate green tinge and the appearance with which they were familiar, and that it was no use to keep any other than copper-tinted peas in stock. In the opinion of the traders in preserved peas the sulphate of copper is a harmless and necessary addition, and is permitted by clause 1 in section 6 of the Sale of Foods and Drugs Act, viz. :—" Where any matter not injurious to health has been added to the food or drug, because the same is required for the production or preparation thereof, as an article of commerce in a state fit for carriage or consumption, and not fraudulently to increase the bulk, weight, or measure of the food or drug, or to conceal the quality thereof," an offence is not committed.

Let us first consider the allegation of the traders that sulphate of copper is necessary to the preparation of the article in a fit state for carriage and consumption. It is only necessary to point out in answer to this allegation that 4 out of the 14 traders in preserved peas, whose goods were reported on by M. Pasteur, on 8th February, 1877, did not find it necessary to add copper to their peas; and what is more striking, when next year he again reported to the French authorities on 15th March, 1878, on 25 samples of tinned foods, he only found copper in 6, showing the benefit which accrued from the action of the authorities in the preceding year. In 1877 there were $3\frac{1}{2}$ adulterators to 1 non-adulterator; in 1888 there were 4 non-adulterators to 1 adulterator. It is therefore proven that the sulphate of copper is unnecessary to the proper preservation of the vegetable. But the preservation of French trade monopoly in such articles as preserved green peas is a matter of serious importance to the French traders, as it involves a sum of several millions of pounds sterling annually, and the British market is the most important outlet for these products. As the ignorant English consumer demands that his preserved peas shall be green, the French trader, with characteristic French politeness, tries hard to please him, and seeks to prove that the salts of copper which we have hitherto considered to be virulent poisons are quite harmless when added to green vegetables. Notwithstanding the numerous cases of poisoning of individuals and of families by the contamination of food cooked in uncleansed copper vessels, they now assert, on the authority of M. Galippe, that the practice of cooking foods in copper vessels is a perfectly safe one, and they bring forward in proof of this assertion the case of M. Galippe, who states that for over a year he and his family partook of acid foods prepared in untinned copper vessels and did not suffer in health. In answer to such statements, we have only to point out that numbers of

other people have suffered very severely from unwittingly trying the same practice, as may be easily proven from numerous well known examples recorded in the works of the writers on toxicology—English, French, and German authors are agreed on that point. One of the most striking cases of wholesale poisoning by foods so contaminated is recorded by Mr. G. H. Fasbroke, in the *Sanitary Record* of 15th April, 1884. Seventeen inmates of a poorhouse were poisoned by soup cooked in a dirty copper boiler. The symptoms in all these cases were most characteristic symptoms of copper poisoning, as any one acquainted with the subject may ascertain by reading Mr. Fasbroke's account of it, and one of the patients died after suffering from all the symptoms of acute poisoning by a salt of copper. Mr. Fasbroke also refers in this paper to another case which came under his notice, in which six or seven persons at a private dinner party partook of a bottle of wine contaminated by sulphate of copper, and suffered in consequence from precisely the same train of symptoms as the paupers above referred to.

A still more recent proof is recorded in a paper by M. Garnier, in this month's number of the *Annales d'Hygiene*, where he gives an account of his experience in this matter. I shall read to you the result of some of his experiments with cooking utensils made of an alloy of 75 per cent of copper and 25 per cent of nickel. These experiments were devised for the purpose of ascertaining if any of the copper or nickel was given up to the foods cooked in the vessel :—(1) He found that both hydrochloric and lactic acids dissolved large quantities of both metals ; (2) Fresh onion-soup, eaten as soon as it was cooked in these vessels, had a disagreeable metallic taste, but digested. When the onion-soup was allowed to remain for four hours in a stewpan, in the corner of the cooking stove, and was then partaken of, it was found to have a disagreeable metallic taste, and it speedily caused violent vomiting. The surface of the soup had a very light, but quite distinctly greenish colour, caused by the corrosion of the copper, by the oxalic acid of the onions, and the lactic acid of the milk.

Here is fresh proof that an article cooked in a copper vessel is not safe or wholesome for human food. It is a remarkable fact that the vessels referred to by M. Garnier were perfectly clean and new copper vessels. It is quite true that, as a rule, copper cooking utensils kept scrupulously clean, and in which the food is not allowed to lie for any length of time, may not produce any appreciable effects on the health of persons who use such utensils. In M. Galippe's family the vessels and food must have been carefully attended to. The very fact that his family did not suffer from their food as M. Garnier suffered from his onion soup, proves that this was the real explanation of their immunity, and not as, he supposes, the mild and non-poisonous nature of copper salts.

These, and numerous previous cases on record, show the wisdom of the answer of M. Pasteur to the negative results of M. Galippe, who affirms the harmlessness of the salts of copper in articles of food. "These results," Pasteur writes, "will only be of value for the conditions in which they were carried out on such and such an animal, or on such and such a human being, but generalisation would be rashness." The same observation applies with equal force to the statements of Dr. Paul and Mr. Kingzett, whose interesting experiments on preserved copper-tinted peas are detailed in a paper published in the *Pharmaceutical Journal* for 22nd September, 1877. These gentlemen took three-tenths of a grain, extracted from the peas, of sulphate of copper daily for seven days, without any evil result. They found that a large proportion of the copper so taken passed off by the bowel, and was therefore unabsorbed. They say that the greater part of the copper in preserved peas, when eaten, will pass likewise out by the bowel undissolved and unabsorbed, and on the strength of their experiments they allege that preserved peas tinted by copper salts are absolutely innocuous to health. It is remarkable that in the very paper in which these observers make these statements, they prove that all the copper added to the peas is found to exist in actual combination with the peas themselves; that it is not shed into the liquid matter found on the tin (as has been alleged by others without any experimental proof of the fact), nor is it parted with in the cooking process. They further prove the very important fact that by artificial digestion in a fluid analogous to the gastric juice the copper can be entirely dissolved out of the peas, but the process of complete solution of the copper occupies a much longer time than the process of digestion in the human stomach. Their conclusion is that "it may be presumed that in stomachic digestion preserved peas give up their copper to solution, but the extent probably depends on the acidity of the gastric juice, the activity of the pepsine ferments, and the time during which the process of gastric digestion is carried on." They believe that when the food passes out of the stomach, and the digested mass becomes alkalinised by the secretions of the liver, pancreas, and bowel, that the copper is precipitated as a phosphate, and no longer absorbed. This latter observation applies to the administration of copper even in medicinal compounds. It is never all absorbed. But the important points proven by these observers are—(1) That all the copper originally added to the peas is carried into the human stomach, none of it being lost in transit or in cooking in water. (2) That the gastric juices dissolve some of the copper. How much they cannot say. Admitting the correctness of the observations and experiments of Messrs. Paul and Kingzett, and that traces of copper may be normally found in cereals, and sometimes

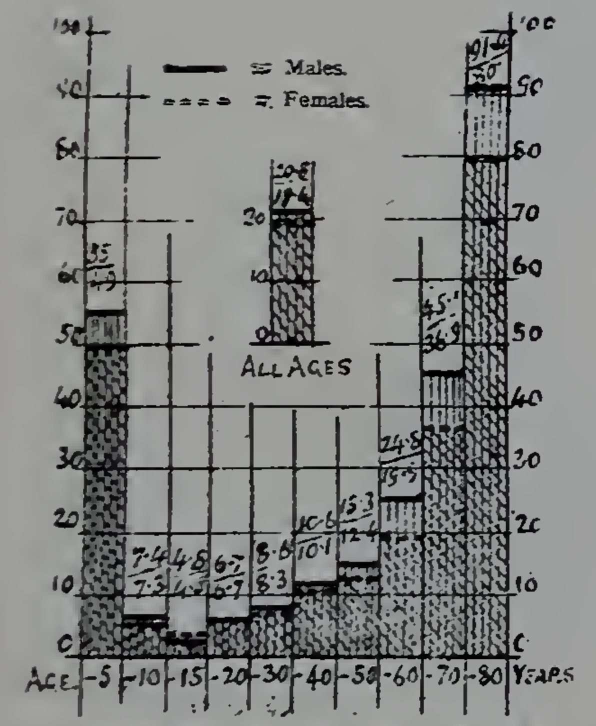
exist even in bread to the amount of one-thirtieth of a grain to the lb.; admitting also that a minute quantity of copper is a normal constituent of the human body, about one-thirtieth of a grain being found in the human liver, and smaller traces in the kidneys and in the blood—all these facts being admitted, I still maintain that the large quantity of $1\frac{1}{2}$ to 3 grains to the lb. found in preserved peas is a danger to health, and should be prohibited. We have seen that it is soluble in the gastric juices, and we know that copper is a cumulative poison. We know that persons may take even more than the dose taken by Messrs. Paul and Kingzett, and for a much longer time without any injurious effect, but we know as a matter of common medical experience that the time does come when such small medicinal doses as one-fourth of a grain of sulphate of copper come to exercise an injurious effect on the health. It impairs the appetite, it weakens the digestion, it produces, first, constipation of the bowels, and after a little longer administration, diarrhœa and vomiting. I have eaten these copper-tinted peas experimentally, and I have often detected them when presented, both at public and private dinners, by the harsh metallic taste of the inferior brands. At an ordinary dinner I estimate, from trials which I have made, that an adult will readily eat about one-third of a pound tin of these peas. This represents from half a grain of sulphate of copper up to a dose of nearly a grain, according to the brand. Every person who takes such peas suffers in respect that the food is less digestible and less nutritious than it should be, and while I admit that healthy persons may experience no inconvenience, I am convinced that there are delicate persons and children to whom even one dose of half-a-grain of sulphate of copper would prove highly injurious and even dangerous. Even M. Galippe and the Parisian Society of Medicine determined ten years ago (after full consideration of the negative facts stated by Galippe and others) that it was necessary in the public interest to prosecute manufacturers who introduced more than one-third of a grain of sulphate of copper to the pound of dried vegetables. But I object to this amount being allowed. Merely negative facts should not, in my opinion, be permitted to bolster up a practice which is not only utterly useless, but entirely pernicious and dangerous to the public health.

THE VITAL STATISTICS OF CHILDREN OF THE SCHOOL AGE IN SCOTLAND.

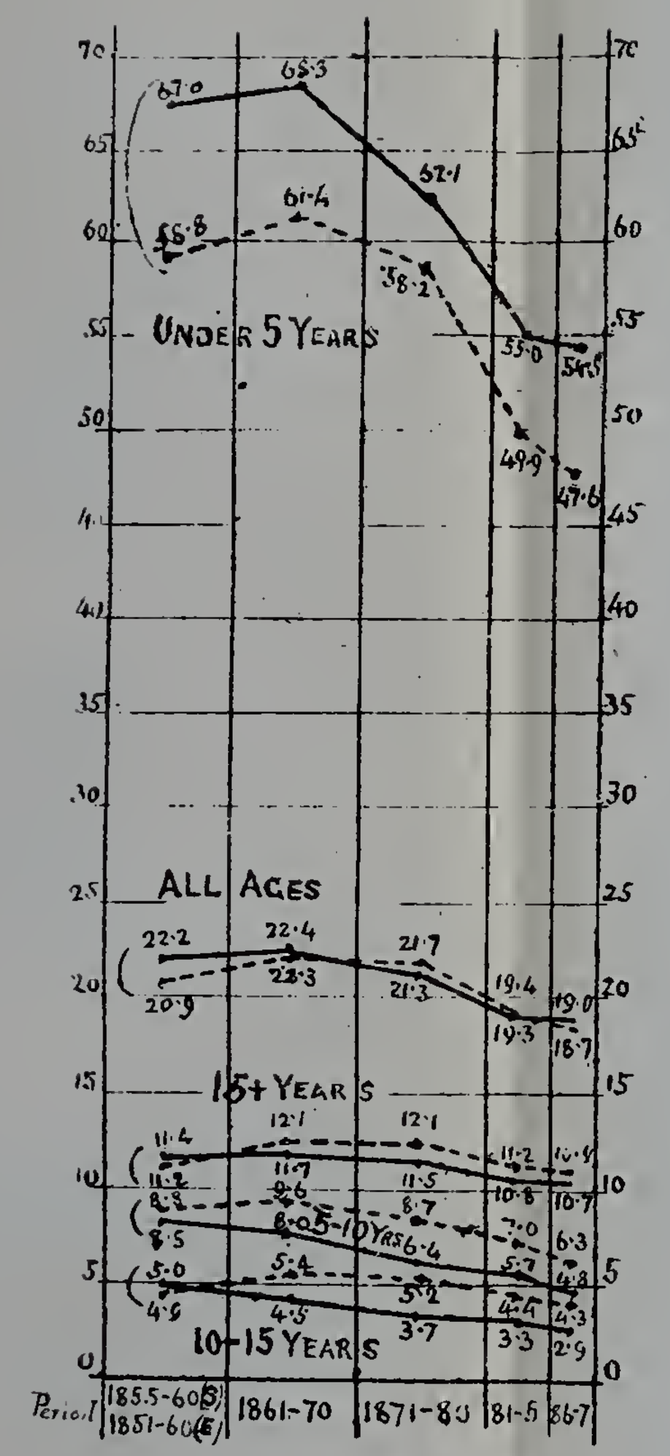
By MATTHEW HAY, M.D.,

Professor of Medical Jurisprudence, University of Aberdeen; Medical Officer of Health, City of Aberdeen.

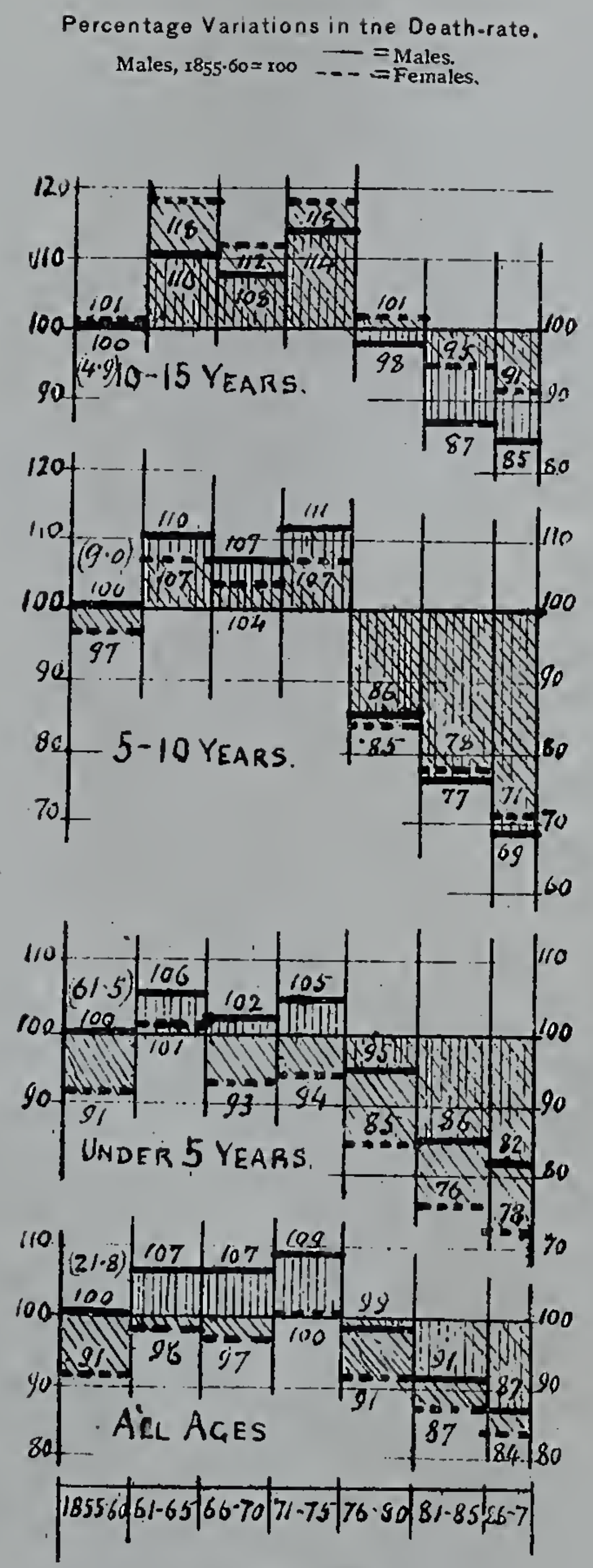
The health of the children of a country should always demand the chief attention of sanitarians, for children are more amenable than adults to sanitary influences, and it is to them we must look for the men and women of the future. If we care sufficiently for the health of the child, we may, to a large extent, disregard the health of the adult. A special factor in the environment of child life is the school, and all that it means. Scotland has ever been distinguished—at least since the Reformation—by its love of the school; and a large proportion of all her children were in regular attendance at school prior to the Education Act of 1872. But that Act, as we all know, rendered school attendance obligatory, and naturally added to the proportion of school-attending children, large as it had previously been. The school factor is, therefore, now a compulsory and constant factor in the life of every ordinary child; and as it extends over several years of the child's life, it is one which is probably having, from a sanitary stand-point, much influence for good or for bad, and it therefore invites the earnest attention of an Association such as this. I am not sure that sanitarians in general have as yet given as much attention to the subject as it deserves. The leading text-books on hygiene in this country practically ignore it, though a good deal is said about the hygiene of barracks and prisons. Doubtless, there are a few small special treatises on the subject, but they are far from exhaustive, and barely touch what are, in my opinion, some of the most vital points. No better evidence of the apathy with which the hygiene of the school is regarded can be obtained than by reference to the clause in the Scotch Education Code, which



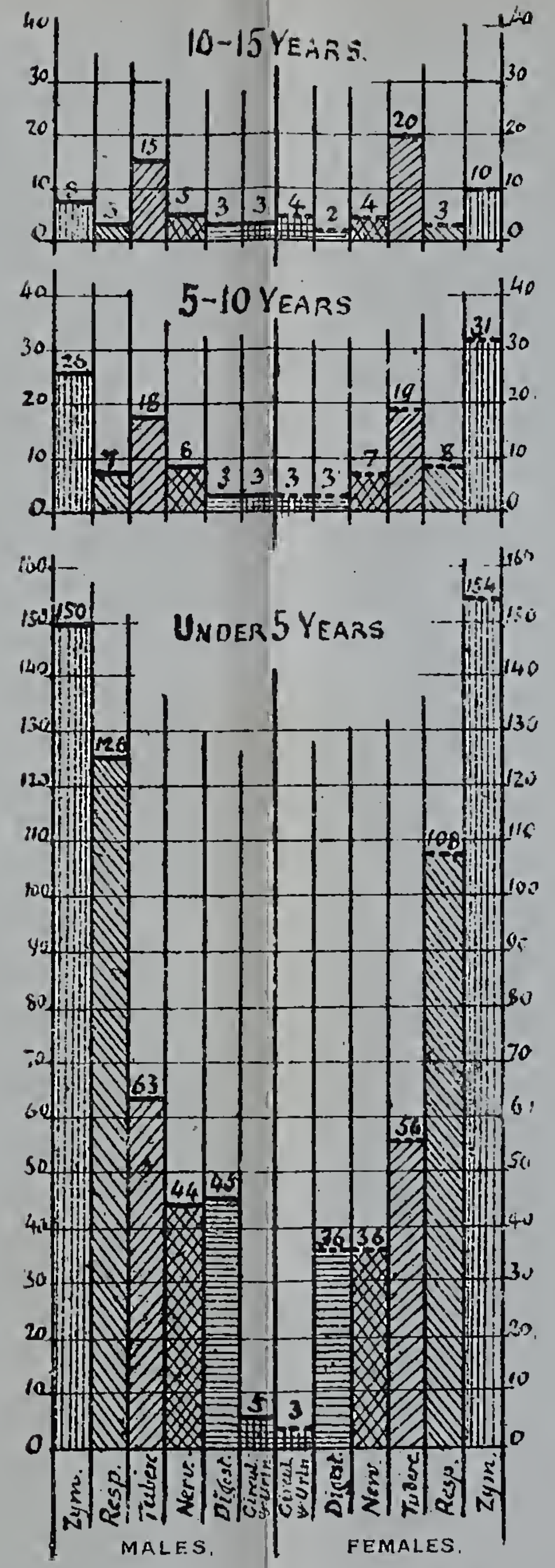
1.—Mean Annual Death-rate, per 1000 of population, at each Age.
1876-85.



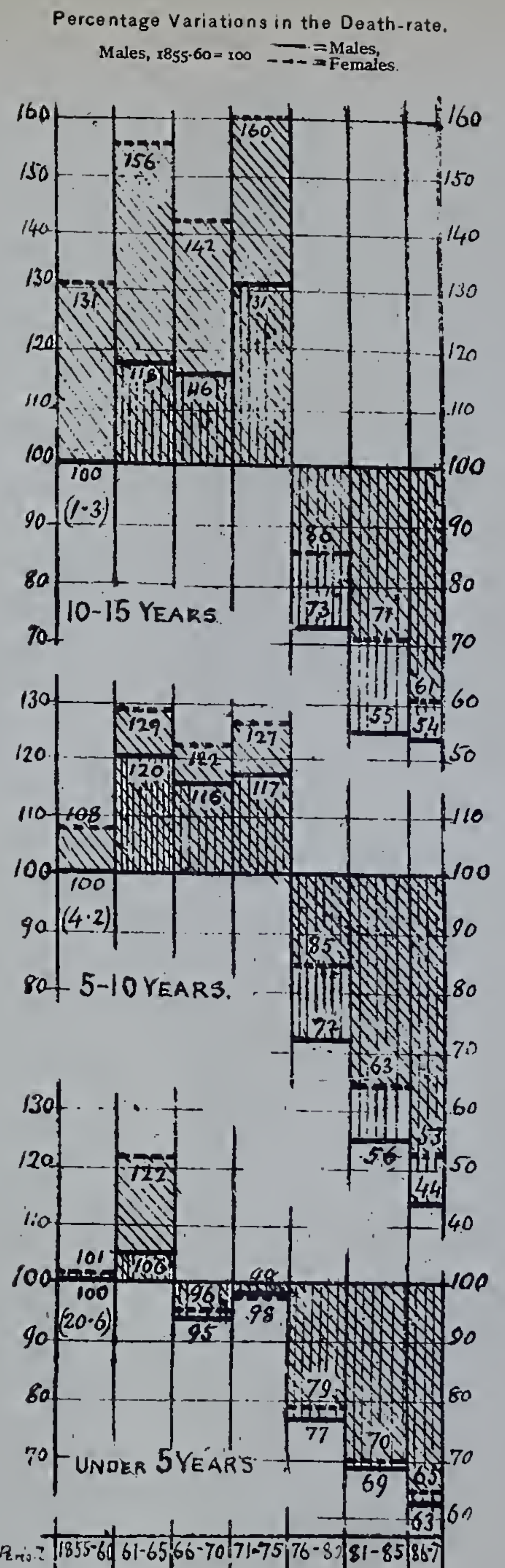
2.—Mean Annual Death-rate from all Causes, per 1000 of population at each Age, in Scotland and England.
— = England. --- = Scotland.



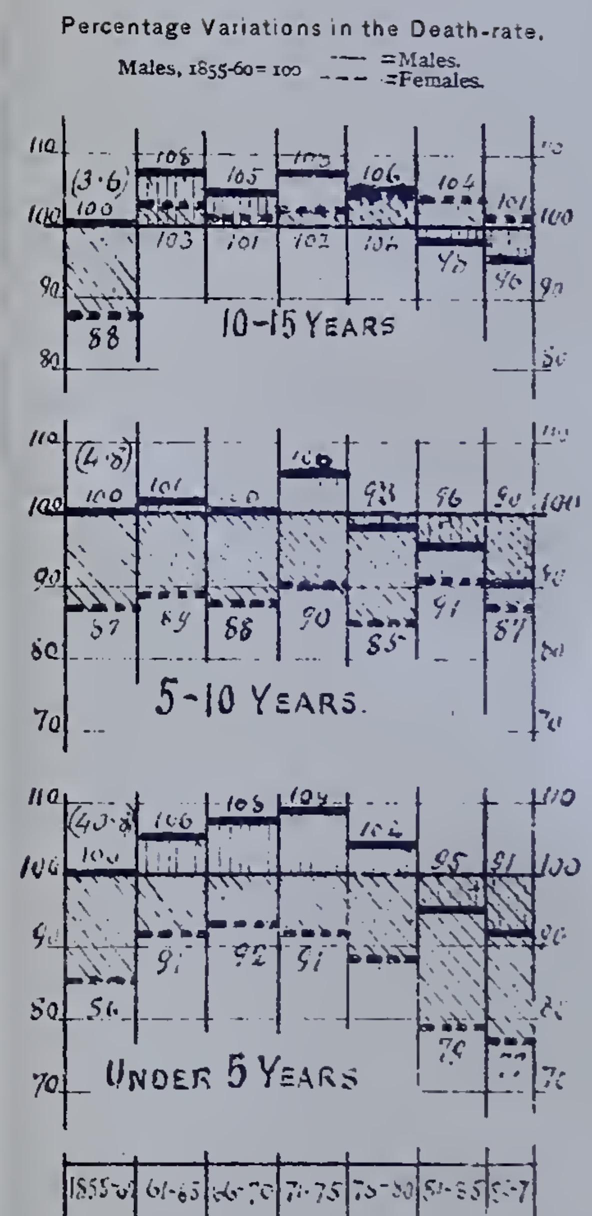
3.—All Causes.



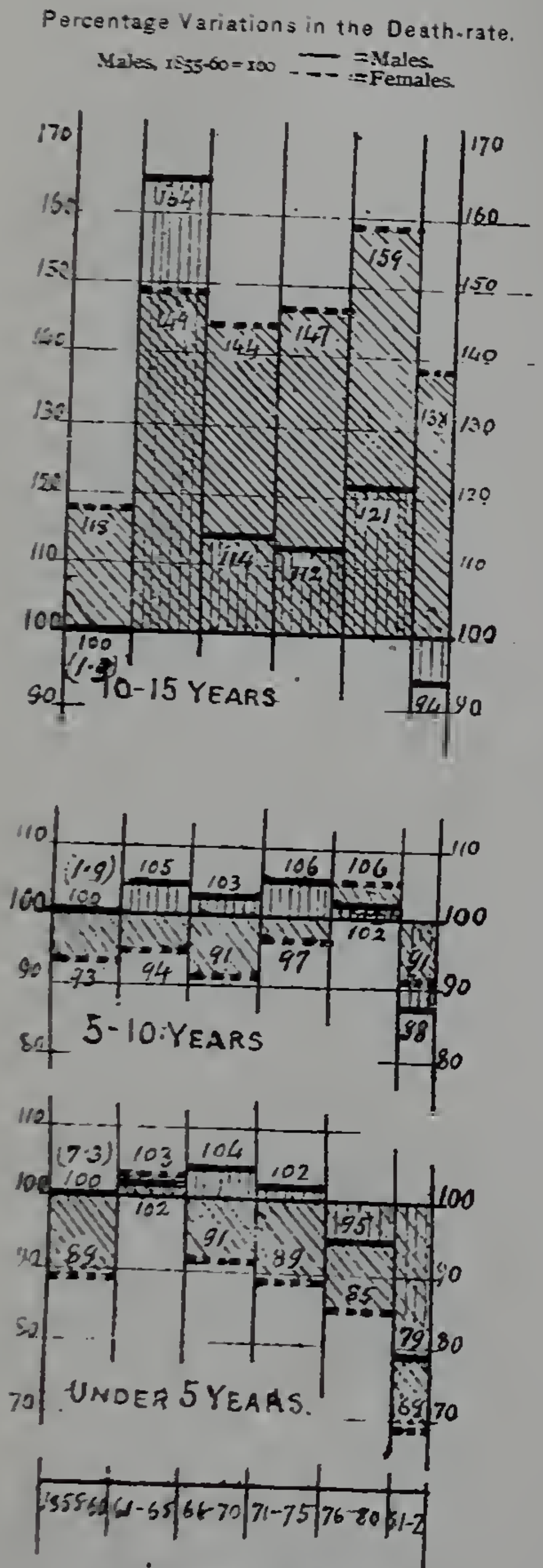
4.—Mean Annual Death-rate, per 10,000 of population, from Groups of Diseases.
1876-85.



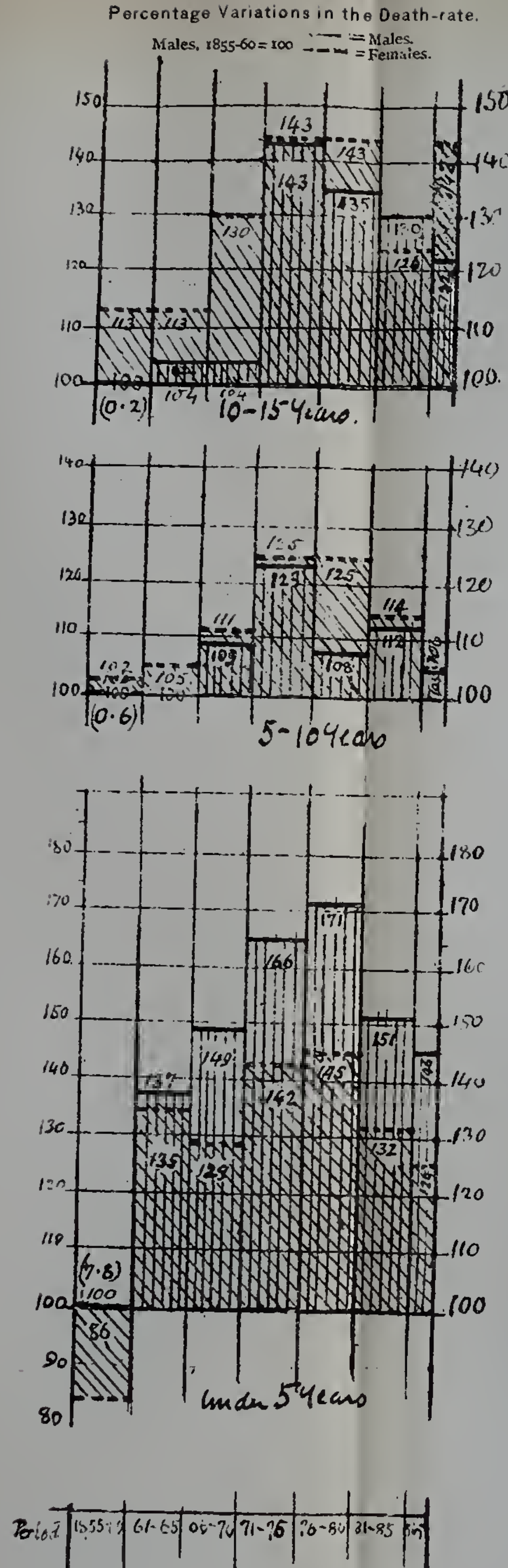
5.—Zymotic Diseases (including Croup).



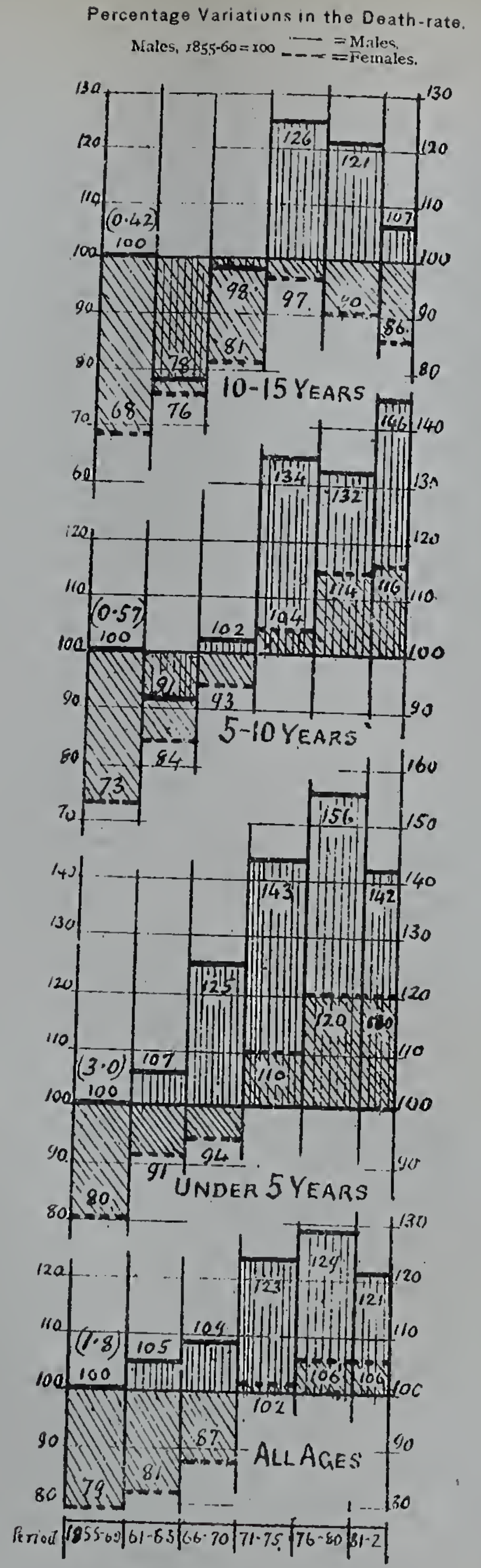
6.—All Causes (excluding Zymotics).



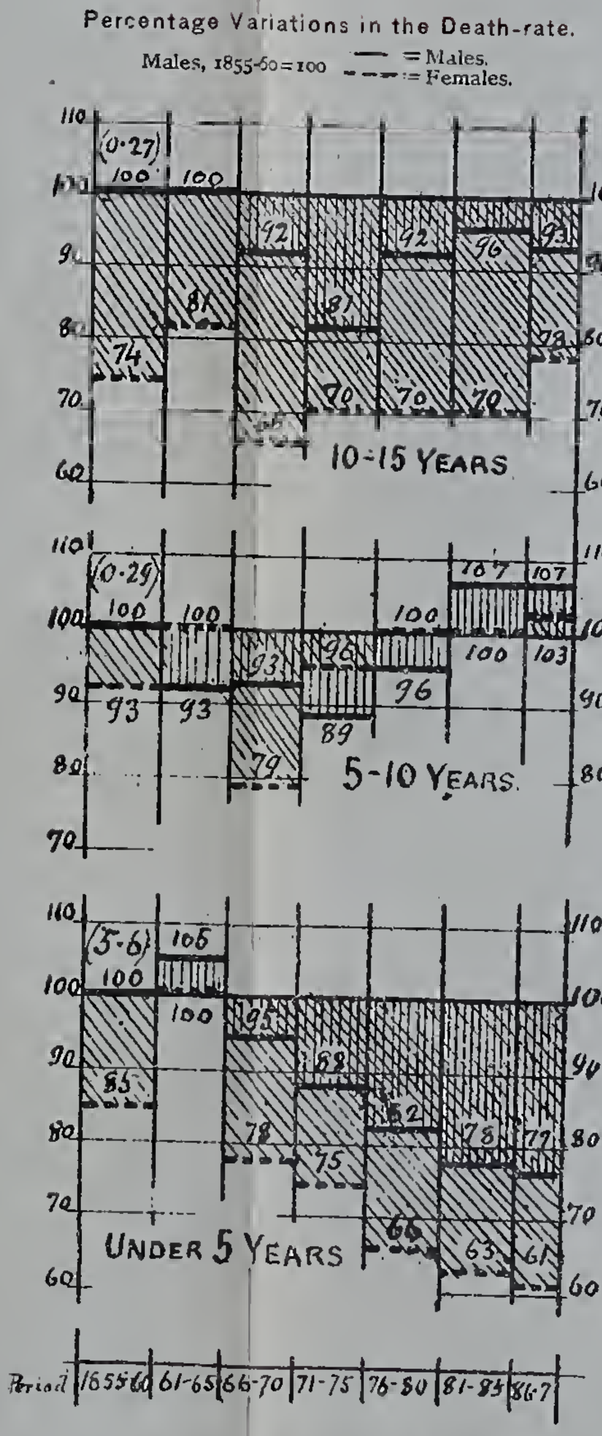
7.—Tubercular Diseases (including all forms of Hydrocephalus).



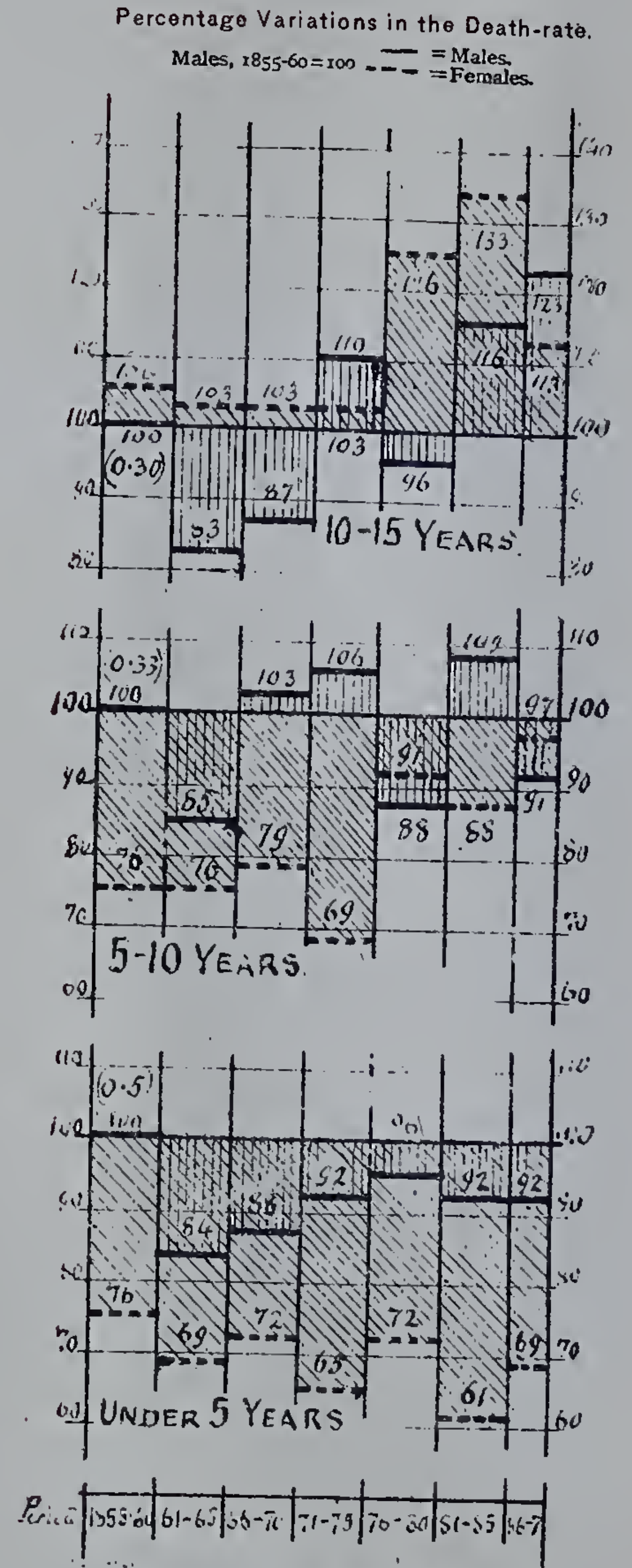
9.—Diseases of the Respiratory System (excluding Phthisis and Croup).



10.—Nervous Diseases (excluding Hydrocephalus).



12.—Diseases of Digestive System.



13.—Diseases of Circulatory and Urinary Systems (including Dropsy).

requires only 80 cubic feet of air-space for each scholar, and that only in state-aided schools. My colleague, Professor Carnelley,* has busied himself for the last year or two in analysing the air of various public schools in Aberdeen and elsewhere, and it is astonishing to find how foul the air of many of these schools is. Stimulated by the results of such investigations, the hygiene of schools is becoming one of the questions of the day, and it is, therefore, not unbecoming that I should bring the subject under your notice at this time.

The particular department of school hygiene—namely, the vital statistics of children of the school age—with which I propose to deal is, I fear, not likely to excite a very lively interest on your part; for, dress figures as one may, they will always retain for most persons an uninviting stiffness and frigidity. Yet they represent the facts to which appeal will constantly have to be made in judging of the effect of the school on health; and a study of them for past years forms, therefore, an appropriate preliminary to other kinds of investigations connected with school hygiene.

In order to render the inquiry as complete as possible, and to give due weight to the conclusions to be drawn from it, I have extended it over the whole of the available data since the commencement of the registration of deaths, in Scotland, by the State in 1855. These data as you are all aware are to be found in the Detailed Annual Reports of the Registrar-General, the last of which, so far as issued, is for the year 1887. In these Reports merely the number of deaths from each disease or group of diseases at each age is given. But as the population is always increasing, and at a varying rate, it is impossible to compare these numbers for successive years with any degree of confidence in the result without first converting them into rates for the population. And in dealing with the statistics of particular ages it is necessary to go farther, and ascertain the rates for the proportion of the population at the particular age. Moreover, the Registrar-General, like other individuals, has his vagaries and occasionally changes his mode of classification of the causes of death. Twice since 1855 has there been a change in the classification, and on each occasion serious alterations were made in the composition of certain groups of diseases. For example, "teething," a very common cause of death among young children, was classified under diseases of the digestive system until 1877, when it was grouped with developmental diseases; but it was re-transferred to the former in 1883, when the Registrar-General, evidently

* The all too early death of Profesor Carnelley, which occurred shortly after the reading of this paper, is deeply lamented alike by chemists and sanitarians. It is, however, gratifying to know that the world is not to lose the advantage of his more recent and unpublished researches on school ventilation. An account and digest of all his researches on the subject was almost ready for the press before his death, and he was able to make arrangements for its posthumous publication.

ashamed of his indecision, re-christened it "dentition." Many other diseases have been similarly moved about, so that without first re-constructing the various classifications on one common plan it is impossible to institute a comparison between the death-rate from a certain group of diseases, at one period, with that from the same group at another period. Sometimes it is even impossible to effect the re-construction. This is the case with two very important groups of diseases, namely, the groups of "brain and nervous diseases" and of "tubercular diseases." Up to 1883 the re-construction is possible; but during 1883, and in all subsequent years, the disease known as hydrocephalus, or "water in the head," all cases of which had previously been placed under "tubercular diseases," was quite properly divided into acute hydrocephalus, or the truly tubercular form of it, and into chronic hydrocephalus, or ordinary "water in the head"; but while the number of cases of the former variety was duly registered under its proper designation and classed with tubercular diseases, the number of cases of the latter was, without any designation, added to, and mixed up with, the *et ceteras* of the group of "brain and nervous diseases." It is therefore impossible to ascertain from the Registrar-General's Reports to what extent any apparent increase, between 1882 and 1883, in deaths from nervous diseases was due to the added, but unnamed, cases of hydrocephalus; and similarly, it is impossible to say to what extent any apparent decrease in the deaths from tubercular diseases is due to the transference of chronic hydrocephalus to nervous diseases. The year 1883, therefore, marks a break in the record of these two groups of diseases, and precludes any exact comparison of the numbers of previous years with those of subsequent years. I have detailed this example partly to illustrate the difficulties of the inquiry, and as a warning to any of you who may be tempted to draw certain inferences from the returns of the Registrar-General, and partly also to explain how it is that a break appears in the statistics which I am now about to give you of these groups of diseases.

Another difficulty, to which I must very briefly allude, is one for which the Registrar-General is not responsible. It is the uncertainty as to the real cause of death. Medical men are sometimes unable to diagnose the nature of the illness from which the patient dies, and, perhaps, still more often they state the cause of death in the usual death certificate in a loose and careless fashion. For example, dropsy, which is only a symptom of a disease, and not the disease itself, which is usually situated in the heart or kidneys, is frequently returned as the cause of death. Deaths from dropsy cannot therefore be correctly classed with deaths from either group of diseases—heart or kidneys—and have to be separately placed. Their number is rapidly lessening in the Registrar-General's returns owing to improved

diagnosis and greater care in certification; but this diminution causes an apparent increase of deaths in recent years from diseases of the heart and kidneys. To obtain anything like a reliable notion of the variations in the death-rates from diseases of these organs, it is accordingly necessary to place them in one group and add all the deaths from dropsy.

You will observe, therefore, that I have done what I could to obey that fundamental rule in all statistical inquiries which requires that a comparison shall not be made between things which are not exactly similar.

And now a remark as to the age-periods selected for examination. The average school age probably extends from about the fourth or fifth year of the child's life to the thirteenth or fourteenth year; and if it were desired to investigate the effects of the school upon children during their actual attendance at it, we should have to select this range of age. But, unfortunately for this purpose, the deaths at each year of age are not separated by the Registrar-General, except for ages under 5 years. Above 5 years, in England as well as in Scotland, the ages of persons dying are grouped into periods of 5 years in the earlier part of life, and in the later part into periods of 10 years. Thus, after 5 years of age, and at the ages corresponding to those of school attendance, it is possible only to obtain the number of deaths among persons between 5 and 10 years of age, and between 10 and 15 years of age. These age-periods I have therefore been obliged to take for my present purpose, and not altogether unwillingly, inasmuch as if they do not exactly cover the average period of school attendance, they cover a period during which the effects of school-life will be even more felt. For the children under 5 years of age in attendance at school are not large in number, and are not likely to have begun to be seriously affected by the hygienic influences of the school; and the children of 14 or 15 years of age, though they may have in large part left school, are not yet free from its consequences. For the sake of comparison, I have also in every instance given the statistics of children under 5 years of age; and, in a few cases, with the same object, I have added those of "all ages," and of ages subsequent to 15 years. These comparisons I regard as of the greatest importance, especially the comparison with children under 5 years. Children of this age supply us with a kind of normal or standard in such an inquiry as the present. They represent the only part of the population which has not been subjected to school influences; and if, as we shall frequently find, a certain change in the death-rate of children of the school age is also taking place concurrently in children under 5 years, it will be reasonable to conclude that the cause of the change is not to be sought in the influence of the school.

As regards the method pursued in setting forth the results

of the inquiry, I have endeavoured to present these as largely as possible in a graphic form. The diagrams, for the most part, represent the mean annual variations in the death-rates from the chief groups of diseases in successive quinquennial periods * since the commencement of registration in 1855, up to and inclusive of 1887. In order to enable you the more readily to compare the proportional rise and fall in the death-rate from a group of diseases at an age-period during the successive quinquennia, I have taken the mean annual death-rate from the group of diseases, among males of that age-period for the first quinquennium, 1855-60, as 100, and have represented all variations of the death-rate in subsequent quinquennia as proportional to this. The death-rate among females is stated in similar proportion to the male death-rate in the first quinquennium. It would have greatly simplified the inquiry to have left the sexes undistinguished, but the results would have lost much of their interest and practical importance. This mode of percentage representation will also help us to a ready comparison of the proportional rise and fall in the death-rate at one age-period, with that at another age-period. This would have been difficult even had the rates at the different ages been drawn to one scale (see Fig. 2). For in comparing a normally high death-rate, say as among children under 5 years of age, with a normally low one, as among children between 10 and 15 years of age, a fall or rise of the same *proportion* in the death-rate at the former age as at the latter age, would be represented by a much more acute rise or drop in the one case than in the other, in the line of the actual death-rate.

This particular method of graphic representation, while it facilitates comparisons, renders it, of course, impossible to ascertain directly the actual death-rate from the diagram. You will, however, observe a number within brackets, attached to the line representing the male death-rate for 1855-60. That number is the actual death-rate per 1,000 of living males during that period from the disease represented on the diagram; and by the aid of the figures for the percentage variations, it is possible without much difficulty to ascertain the death-rate for any quinquennium either among males or females.

As a further help to gaining a conception of the actual death-rates at the different age-periods from each group of diseases, I have prepared a diagram which represents on one scale the various death-rates during the decennium of 1876-85 (Diagram 4).

We shall now proceed, after these preliminary explanations, to a brief study of the various diagrams and tables.

Let me in the first place remind you that children under five years of age constitute fully 13½ per cent of the population of Scotland; children between five and ten years, about 12 per cent;

* The period 1855-60 is reckoned as a quinquennium, though it actually contains six years.

and children between ten and fifteen years, nearly 11 per cent. The proportions are almost exactly the same in England. About 23 per cent, therefore, of the population, or nearly one-fourth, are of the ages selected by us as covered by school attendance or its effects. This is a large proportion, and the healthiness of this age-period must materially affect the health of the community.

Death-Rates from All Causes at Different Age-Periods (1876-85). —Diagram 1 represents at quinquennial periods of age to 20 years, and afterwards at decennial periods, the mean annual death-rate from all causes during the ten years ending 1885. The rates for each sex are represented separately. It also shows on the same scale the death-rate at 'all ages.' In looking at such a diagram one is reminded of the correctness of Addison's well-known description of the bridge of human life across the vale of misery, though he wrote long before Registrar-Generals were created. "These hidden pitfalls," he says, "were set very thick at the entrance of the bridge, so that throngs of people no sooner broke through the cloud, but many of them fell into them. They grew thinner towards the middle, but multiplied and lay closer together towards the end of the arches that were entire." The death-rate under 5 years of age is greater than the death-rate between 60 and 70 years of age. This heavy mortality falls chiefly on the first year of infant life. Between the ages of 5 and 10 the death-rate is only about one-seventh or one-eighth of the rate under 5 years. The rate between 10 and 15 years is still lower, and is the lowest at any age-period. After this period, the death-rate gradually rises, slowly at first and rapidly afterwards. Excepting the period of 15 to 20 years, the two age-periods of 5 to 10 and 10 to 15 are the freest from death, and presumably the freest from sickness. You will further observe that the death-rate among males is higher than that among females at 'all ages' and at all age-periods, except between the ages of 10 and 15, when it is lower, and between the ages of 15 and 20, when it is the same. This accounts for the preponderance of females in the population, though at birth they are outnumbered by the males. But the important fact for us to note is *the greater susceptibility to disease, or liability to death, among males between 5 and 10 years, and among females between 10 and 15 years.* This is important as indicating that special care is needed at the one period for the one sex, and at the other for the other sex. It may be added that the greater mortality among females between 10 and 15 years is entirely due to tubercular diseases.

Variations in the Death-Rates from All Causes at the School Age-Periods since 1855.—Let us now consider the variations in the death-rates from all causes at the two school age-periods since the commencement of registration. Diagram 2 shows these death-rates drawn to scale, and compared with the death-rates under 5

years of age, at 15 years and upwards, and at 'all ages.' Let us meantime disregard the comparison with the corresponding English death-rates which this diagram also show. You will observe that at the three age-periods under 15 years a rise occurs from 1855 to 1870, followed by a steady fall up to 1887, or the last year for which data are obtainable. The death-rate at 'all ages,' and consequently the rate at ages above 15 years, continued to rise during 1871-80, and has since been falling tolerably rapidly. Persons under 15 years were therefore ten years sooner in profiting by the modern sanitary movement than were persons at later ages. This, as I shall have occasion to show later on, was mainly due to a lessened mortality from zymotic diseases. The actual proportional decline at each age-period, for males and females, is seen in Diagram 3, which shows that at the three age-periods under 15 years, the greatest decline has taken place among children between 5 and 10 years of age, being about 22 per cent for both sexes, or in other words, for every 5 children of that age who died in 1855-60, only 4 died in 1880-85. The next greatest decline is among children under 5 years, and the least is among children between 10 and 15 years, the proportional decline at all three periods being greater than the decline at 'all ages.' It will also be gathered from this diagram, which represents the progress of the death-rate over quinquennial periods of time, instead of decennial periods as in Diagram 2, that the period of highest death-rate for both groups of children of the school age was 1871-75, whereas for children under 5 years of age it was 1861-65. One is tempted to recognise in this the effect of the Education Act of 1872 in forcing children into schools of insufficient accommodation, resulting in the baneful effects of overcrowding. But a glance at the death-rate for all ages above 15 years shows that persons unaffected by the operation of the Act were also suffering during the same quinquennium from an excessive mortality.

Again, observe in Diagram 3, as in Diagram 1, the continuously higher mortality above 10 years of age among girls as compared with boys, and the relatively lower mortality under 10 years of the same sex. Observe also that while the former is not appreciably tending to approximate itself to that of the boys, the latter is being overtaken by the more rapidly decreasing rate among boys; the conclusion being, as between boys and girls of the two school age-periods, that the health of the boys has more rapidly improved than that of the girls.

Death-Rates from the Chief Groups of Diseases.—Let us now pass to the consideration of the death-rates from the chief groups of diseases, in other words, to an analysis of the component parts of the death-rate from all causes. Let us look first at Diagram 4, which represents graphically, for 1876-85, the mean annual death-rate, per 10,000 of population, from the chief groups of diseases at

the two school age-periods, and at the period under 5 years. The preponderating cause of death at each of the two lower age-periods is zymotic diseases, chiefly measles, scarlet fever, and hooping-cough. Let me here remind you of the fact, not illustrated by these diagrams, that scarlet fever, long the most fatal of the commoner zymotic fevers, is now fast becoming, under the influence of sanitary preventive measures, the least fatal, and it is greatly to be desired that as much care were given to the prevention of measles and hooping-cough. The former is generally regarded with much greater fear than either of the latter, and yet in most of the large towns it has been the experience for several years past that, in order of fatality, hooping-cough comes first, as causing the largest proportion of deaths to sicknesses, measles next, and scarlet fever last. Measles and hooping-cough are peculiarly young children's diseases, the susceptibility to their infection, or at least the liability to mortality from them, being decidedly greatest under 5 years, and diminishing rapidly afterwards. For example, for every 1,000 children under 5 years of age, who appear in the English Registrar-General's Reports as having succumbed to measles, only 80 between 5 and 10 years of age appear, and 8 between 10 and 15 years. In the case of hooping-cough the differences are even more striking, the numbers being 1,000, 40, and 2. Scarlet fever, on the other hand, is a disease which, though preferring the young, spreads itself higher up in the age-periods, the numbers being about 1,000, 430, and 100, for the three age-periods under discussion. The great stress of mortality from measles and hooping-cough on the age-period under 5 years suggests the desirability of prohibiting the attendance at school of children at that age, as children are more exposed to contagion at school than at home. I believe that if no child was admitted to a public school until after it had passed its fifth year, it would materially lessen the mortality from zymotics, which are the greatest enemy of child life; and the loss in education would be immaterial.

To return to the Diagram, one cannot but be struck by the high position occupied by tubercular diseases as a cause of death during the two school age-periods. Tubercular diseases, I may say, include not only phthisis or tubercle of the lung, but also tubercle of the brain and of the bowels, the latter two forms being tolerably common among young children. High, however, as deaths from tubercular diseases are at these periods, they are still more numerous among children under 5 years of age, though they are at that age-period overshadowed by a much greater mortality from respiratory diseases. It will also be observed that while during this age-period more males than females succumb to tubercular diseases, yet during the school age-periods this is reversed, the mortality among females being the greater. Moreover, during these later periods the mortality

from such diseases, after a great drop among both sexes, as compared with the infant period, tends to lessen among males and to increase among females. Deaths from diseases of the respiratory system which, as just remarked, are high under 5 years, decline tolerably rapidly in both sexes during the school age-periods, being, like tubercular diseases, rather more common among females than among males at these periods, and thus differing from what is observed in the infant period. Nervous diseases occupy the reverse position in relation to the sexes, being a more common cause of death among males than females of the school age-periods. It will be noticed, however, that they are also more common, and almost in the same relative proportion, among males under 5 years than among females of the same age. Throughout the three periods there is, with advance of age, a well marked decline in the mortality from these diseases among both sexes, but especially between the infant period and the lower school age-period. The other groups of diseases do not call for special remark.

Variations in the Death-Rates from the Chief Groups of Diseases since 1855.—We shall now consider the changes which have taken place in the death-rates from the chief groups of diseases, in quinquennial periods of time, since 1855.

Zymotic Diseases (Diagram 5).—Let us begin with zymotic diseases. It is satisfactory to observe that although the mortality from zymotic diseases showed a fairly continuous rise from 1855-60 to 1871-75 at both school age-periods, and was thus high when it was falling at the infant period, yet since the end of the quinquennium, 1871-75, its fall has proportionally been more rapid at the school age-periods than at the infant age-period. During 1881-85 the mortality at the school age-periods was reduced to almost one half of what it was in 1855-60, and to much less than one half of the rate during 1871-75. A still further fall at all three age-periods, but especially at the infant period, has taken place in 1886-87. This is a very satisfactory feature in the vital statistics of school children, for zymotic diseases must be ranked as pre-eminent among the preventible causes of death; and it only requires the operation of sufficiently rigorous measures to almost completely suppress them.

The great fall in the mortality from zymotic diseases suggests that the reduction in the death-rates from all causes at these age-periods may be largely, if not wholly due, to this fall. An investigation of the numbers shows that this is practically the case for the school age-periods. For the death-rate from all causes, exclusive of zymotics, between the ages of 5 and 10 was 45 during 1881-85, as compared with 45 in 1855-60; and between the ages of 10 and 15, 36 as compared with 34. The death-rate from the same causes at the infant period is, however, lower in 1881-85 than in 1855-60, being 36 as compared with 38. It

thus appears that, exclusive of the effect of zymotic diseases, the health of children previous to the school ages has improved since 1855, whereas the health of children of the school ages has not improved up to the last complete quinquennium (1881-85), and has even become worse during the later school age-period. It is, however, just to say that there has been a slight improvement during the last quinquennium, and especially in the fractional period 1886-87, as compared with some intermediate quinquennia since 1855-60 (see Diagram 6).

Tubercular Diseases.—Let us now turn to the death-rates from tubercular diseases. A glance at Diagram 7* will show you that the mortality among both sexes has after a slight rise very considerably decreased since 1855-60 among children under 5 years. It has also decreased, but much more slightly, among children between 5 and 10 years. But among children between 10 and 15, it has greatly increased among females, though it has slightly decreased among males. It will, however, be noted with satisfaction that at every age-period there has been a considerable decrease during 1881-82 as compared with the immediately preceding quinquennium. On the whole, therefore, though tubercular diseases are now beginning to be less fatal among children of the school age than they were a few years ago, the extent of the reduced mortality is not satisfactory, when regard is had to the fact that these diseases, especially in the form in which they attack the lungs, are very largely engendered by the breathing of impure air, such as the air of ill-ventilated school-rooms, and are, like zymotics, largely preventible. The next table (8) which is taken from the decennial report of the English Registrar-General for 1871-80, shows very strikingly how great is the effect of impure air in the production of tubercular disease of the lungs.

8.—Comparative Mortality of Males, working in Air of different Degrees of Impurity, from Phthisis and Diseases of the Respiratory System (*Decenn. Report, Eng. Reg. Gen.*, 1871-80).

	Phthisis.	Respiratory Diseases.	Both.
Fishermen,	108	90	198
Agriculturists,	115	122	237
Grocers,	167	116	283
Drapers,	301	129	430
Tailors,	285	186	471
Printers,	461	166	627

Before passing from the diagram of the death-rates from tubercular diseases, it may be well to note, what I drew your

* The reason for this Diagram extending only to 1882 has been given in the introductory part of the paper.

attention to in a previous diagram, that females have continuously suffered much more than males, between the ages of 10 and 15, from tubercular diseases; and that between the ages of 5 and 10 they also have since 1875 begun to suffer more than males, though formerly they suffered less. There is no doubt a greater natural susceptibility to diseases of all kinds among females than among males at the higher school age-period; but this is only a reason why we should endeavour to counteract this greater susceptibility by placing girls under the most favoured circumstances hygienically.

Diseases of the Respiratory System.—A group of diseases closely allied in its incidence with tubercular diseases is that of diseases of the respiratory system. The next diagram (9) shows that the mortality from these diseases has very greatly increased since 1855 at all three age-periods, and still remains high, although at each period there is a decline during 1881-86 and 1886-87 as compared with the immediately preceding quinquennium. In the case of the school age-periods, the acme of the mortality was reached in 1871-75, which might have disposed us, as in the case of the mortality from all causes, to attribute the increase to the overcrowding of the schools consequent on the enforcement of the provisions of the Education Act. But this would be unfair in view of the fact that the mortality at the infant age period had reached even a greater height proportionally during the same quinquennium, although it went still higher in the subsequent quinquennium. This illustrates very well the value of comparing the mortality of the school age-period with that of the infant period. For without such a comparison, the attempt to fix the blame on the Education Act might have passed without challenge. Again, observe that in the school age-periods females suffer more from diseases of the respiratory system than do males.

Whatever may have been the effect of the Education Act in overcrowding schools for a few years, it can hardly be questioned that there is considerable scope for a lowering of the mortality from diseases of the respiratory system. For it is surely possible for us in these days of hygienic enlightenment to make children as healthy in respect of these diseases as they were at the commencement of Registration. Again, look at the table of the English Registrar-General, showing the effects of impure air in producing diseases of the respiratory system, and the remedy suggests itself.

Diseases of the Brain and Nervous System.—Considerable interest attaches to the mortality from diseases of the brain and nervous system. For in recent years a great deal has been said about "over-pressure," and it is difficult, with certain prevalent notions in one's head, to shake oneself free of bias in inquiring how far the Registrar-General's returns support a belief in the existence of "over-pressure." The Diagram (10) I now direct

your attention to bear its own interpretation. It shows clearly that at all the age-periods represented there has been a very considerable and almost continuous rise in the mortality from brain diseases. But, proportionally, the rise has been greater among children under the school ages than among children of these ages. This is a surprising fact and difficult to believe. But the figures do not admit of doubt. It may be that the increase is partly due to improved diagnosis by the physician, who is now ascribing deaths to nervous diseases which formerly would have been assigned to other causes. But imperfect diagnosis affects all ages alike; and the important fact remains that the increase in the mortality from nervous diseases has become proportionally greater among children of the infant period than among children of the school ages. One cannot help remarking, however, the sharpness of the ascent of the mortality at the school age-periods during the quinquennium in which "payment by results" came into force. On the other hand, it will be observed that between the ages of 10 and 15 years, or the ages at which "over-pressure" is likely to be most severe, there has been a steady fall in the mortality among boys as well as girls from 1875 to 1882. At the lower school age-period, however, the rise is maintained to the end, though there is a slight fall among children under 5 years during the last two years embraced in the diagram. The much greater mortality among boys than among girls is very apparent at all the age-periods and throughout all the quinquennia.

Mean Annual Death-rate per 1,000 *of Population.*

	Under 5 Years.		5-10 Years.		10-15 Years.	
	Male.	Female.	Male.	Female.	Male.	Female.
1883-84, . .	5·69	5·06	0·97	1·01	0·56	0·57
1885-87, . .	5·45	4·63	1·00	0·82	0·58	0·50
Percentage of Variation—Rates for 1883-84 = 100.						
1883-84, . .	100	100	100	100	100	100
1885-87, . .	96	91	103	81	104	89
	M. & F. 93		M. & F. 92		M. & F. 96	

11.—NERVOUS DISEASES.

This diagram does not go further than the year 1882, for the reason mentioned in speaking of the methods of classification of diseases by the Registrar-General, so a separate table (11) is provided, which begins with 1883 and ends with 1887, the last year for which returns have been obtained. The mean annual mortality from nervous diseases for 1883-84, is compared with the corresponding mean for 1885-87, and the percentage variations

are also given. It will be seen that at the three age-periods represented, there has been a fall in all the female rates and in the male rate under 5 years; but the other male rates, that is, those of the school age-periods, have risen by 3 to 4 per cent. There is here, therefore, the suggestion of the effects of "over-pressure" among school-boys during more recent years, but it would be difficult to draw any certain conclusion from the figures available, as they cover too small a term of years. The case for over-pressure, therefore, is, so far as these statistics are concerned, not a strong one.

Diseases of the Digestive System (Diagram 12).—I shall not detain you long with the mortality from the remaining groups of diseases, although they present some features of interest. The mortality from digestive diseases at both school age-periods diminished during the first three quinquennia of registration, and also during the fourth at the higher age-period; but during subsequent quinquennia there has been a steady rise. This is the more noteworthy when it is perceived that during these later quinquennia, and indeed since 1865, there has been a steady fall in the mortality from this cause among children under 5 years of age. It would appear that the dieting of school children requires attention. Much, I know has been done in recent years, by popular lectures and by medical advice, in helping mothers to properly feed infants; similar help is evidently needed for the feeding of the older children. I cannot myself say to what extent, or in what manner, modern methods of school attendance may have aided in increasing the mortality from this group of diseases.

Diseases of the Circulatory and Urinary Systems, including Dropsy.—This group may, at first sight, appear to possess little interest for the sanitarian, yet it is not to be forgotten that diseases of this group frequently originate in preventibly insanitary conditions. At the higher school age-period the mortality from these diseases is evidently rapidly increasing (Diagram 13), and is greater among females than males, except in 1871-75 and 1886-87. At the lower school age-period it is very variable, but it has, on the whole, been increasing, though slightly, up to 1885. Under 5 years of age it is gently rising among males, excepting a drop after the first quinquennium, and is falling among females. School life would, therefore, appear to be favouring, more than formerly, the occurrence of these diseases among the older pupils, or at any rate is coincident with it.

So much for the Vital Statistics of the school children of Scotland. As you will have perceived, it is very difficult to draw sure conclusions from these statistics as to the influence of the school upon health. The great difficulty is, of course, to find a proper standard with which to compare the health of the children. If we had a large community in our midst, in which schools were unknown, then, other circumstances of living being equal, we

could use the health statistics of the children of ages corresponding to the ages of our school children for purposes of fair and legitimate comparison. But that is happily unattainable Or again, had it been that very few children attended school before the passing of the Education Act, and very many afterwards, we could have compared the statistics of children previous to the passing of the Act with the statistics of those subsequent to it. This, I have in part been doing, but the chief advantage of the comparison is lost when, as already mentioned, it is known that Scottish children attended school well, and in very large proportion, long before education became compulsory. Still there has been an increased proportion since the passing of the Act, and the character and mode of the teaching have been considerably altered, largely, I fear, in the direction of extending and multiplying the subjects of study. Then payment by results has been added, so that, altogether, school-life for the child has considerably changed since 1872.

Another standard of comparison open to us, also unsatisfactory, but not altogether worthless, is the vital statistics of children of the school ages in other parts of the kingdom, where, possibly, there exist differences in methods of teaching and in the sanitary conditions of the schools. Such a standard readily offers itself to us in the vital statistics of the school children of England. I have accordingly prepared a diagram and one or two tables in which a comparison is made between the statistics of the English and Scottish children for the decennium 1871-80, being the most readily available. I shall very briefly refer you to the chief points of difference.

Comparison of Vital Statistics of English Children with those of Scottish Children at the School Ages.—Firstly, as regards the mortality from all causes (Diagram 2). At 'all ages' this is nearly the same in both countries. Under 5 years of age it is much higher in England than in Scotland. This is probably due to English mothers being, on the whole, worse nurses than Scottish mothers. It is also in part due to the greater proportion of mothers who work in mills in England than in Scotland, and who accordingly send their infants to baby-farms. At each of the two school age-periods the death-rate is distinctly higher in Scotland than in England, and the death-rates of the two countries, though all declining, do not exhibit much tendency to approximate. For every 10 children who die in Scotland between the ages of 5 and 10 years, only 7 die in England, and the proportion at the ages of 10 to 15 years is about the same. The difference is very great, amounting to about 30 to 40 per cent of an excess in Scotland, and is certainly worthy of our attention. It may in part be due to the heavier weeding out of weaklings which takes place in England in the infant age-period, but it can hardly be caused entirely by this.

Mean Annual Death-rate per 100,000 *of Population at each Age; and Relative Proportion between England and Scotland.*

Both Sexes—1871-80.

	All Ages.		Under 5 Years.		5-10 Years.		10-15 Years.		15 Years and upwards.	
	Scot.	Eng.	Scot.	Eng.	Scot.	Eng.	Scot.	Eng.	Scot.	Eng.
	2,171	2,127	5,822	6,310	875	640	524	370	1,212	1,151
Or as	100 :	98	100 :	108	100 :	73	100 :	71	100 :	95
All Causes.										
	...	...	1,563	1,709	382	301	132 :	104	...	...
Or as	...	...	100 :	109	100 :	79	100 :	79	...	...
Zymotic Diseases (Fevers and Diarrhœa).										
	355	287	676	522	197	87	182	93	219	196
Or as	100 :	81	100 :	77	100 :	44	100 :	51	100 :	90
Tubercular Diseases (including all Hydrocephalus).										
	386	376	1,224	1,220	77	56	33	20	205	201
Or as	100 :	97	100 :	100	100 :	73	100 :	60	100 :	98
Diseases of the Respiratory System.										
	205	277	394	908	69	57	46	33	138	143
Or as	100 :	135	100 :	230	100 :	83	100 :	72	100 :	104
Nervous Diseases.										
	...	...	435	(127)	56	18	21	15	...	...
Or as	...	...	...	...	100 :	32	100 :	71	...	...
Diseases of the Digestive System.										
	...	...	40	41	29	27	33	10	...	...
Or as	...	...	100 :	102	100 :	93	100 :	30	...	...
Diseases of the Circulatory and Urinary Systems (including Dropsy).										

14.—Comparison of Scotland with England.

As to the constitution of the death-rates, deaths from zymotic diseases (Table 14) are somewhat more numerous among infants in England than in Scotland, but are less common among children of the school ages. Tubercular diseases are a more common cause of death at every age in Scotland than in England, but especially at the school ages, when the mortality from these diseases is more than twice as great as in England. Deaths from diseases of the respiratory system are about equally common in the two countries at every age-period except the school ages, when they are much more common in Scotland, the proportions being as 10 to 7 and 10 to 6 in the two school age-periods respectively. The mortality

from diseases of the nervous system is greater in England at every age-period (and especially at the infant period), except during the school age-periods, when it is much lower, being about 8 to 10 and 7 to 10 for the two school age-periods respectively. The deaths from diseases of the digestive system and from the circulatory and urinary systems (including dropsy) are also much more numerous in Scotland than in England during the school age-periods, though less numerous at the infantile period.

In freedom from mortality from all the important groups of diseases the balance is decidedly in favour of the English school-child, but especially as regards tubercular and respiratory diseases. I am not sufficiently acquainted with the school hygiene of the two countries to know if any differences exist, but these figures are strongly suggestive of considerable differences. I believe the two countries are working under similar Education Acts and Codes, but it may be that in actual practice important differences have arisen. Of course, I must not forget that just as I have blamed the English mothers for the great mortality of their infants, so, perhaps, ought I also either to commend them for the low mortality of their older children; or to blame Scottish mothers for the high mortality among their older children. In other words, the home influence may be a more potent factor in the case than the school influence. This I must leave to some one else to decide. Be it as it may, the comparison of the school children of the two sister countries appears to me to indicate clearly, as does also the inquiry into the Scottish statistics alone, that there is very considerable room for improvement in the health of Scottish children of the school ages. But I look forward in confident expectation to the time when, as the result of the earnest attention now being given to the hygiene of schools, they will have become temples of health as well as of learning, and when the term "education" will be defined and applied in its broadest and noblest sense, as being a training and moulding not merely of the mind, or even also of the morals, but of the whole body and being.

If time permitted I might have discussed some of the measures which appear to me to be necessary for the advancement of the hygiene of our schools. Let me briefly indicate a few of them in about as many sentences. The first great essential is a sufficiently pure atmosphere within the school-room. This demands not a minimum of 80 cubic feet of space per child, but one of 200; and having regard to the greater prevalence of tubercular and respiratory diseases among females than males, the space should be greater for the former than the latter. I do not believe that the air can, without inconvenience, be kept sufficiently pure if there is less, even with mechanical ventilation, which is, perhaps, the only efficient mode of ventilating schools. Natural modes of ventilation cannot possibly be enough when the cubic space is so

small and has to have its atmosphere so frequently renewed. Why, we even insist on a minimum of 300 cubic feet in a common lodging-house, and in some towns it is 400. And are our children less precious to us than the occupants of common lodging-houses, that we should lock them up for six or seven hours in a space which we regard as utterly insufficient for a tramp?

The next great requirement is sufficiency of superficial space outside the school for a play-ground. No school should be built without very ample provision in this respect, and the Government or the Education Department should fix a minimum of play-ground space per pupil just as of school-room space. It may be expensive to provide a sufficient play-ground, but let us not grudge the expense. There is enough and to spare in this country for so good an object. We spend annually on the unnecessaries of life as much as would provide in one year extensive play-grounds for every urban school in the kingdom. I contend that this, like pure air within the school, is a necessary of life for our children, and should be provided in the same spirit and with the same motive as we would spend our last penny on a loaf to appease their hunger.

Closely allied to the question of play-grounds is that of physical training for boys and girls, but, perhaps, more particularly for the latter, and for the weaker of the boys, who, without being obliged to undertake it, too frequently neglect to have a sufficient amount of physical exercise. Considerable attention is being devoted to this subject at present in Aberdeen, mainly through the efforts of Mr. Cruden, a well known local lawyer, and there is the prospect of every public school in the city being provided with its gymnasium, and with regulated exercise for all the pupils. This is needed in schools all over the kingdom.

Another requirement of importance is the personal cleanliness of the children. This, I should imagine, must be creative of difficulties in schools in the lower quarters of a large town. I do not know how filthy children are dealt with by teachers, but this I know that many of them must be a serious source of pollution to a school. Probably in the near future no school will be considered complete without its baths as well as its sanitary conveniences, and perhaps a prudent and beneficent School Board will add a wash-house and a disinfector. How invaluable will lessons in personal cleanliness to the children be when they grow to men and women! We all know too well how filthy the houses and persons of many of the parents of the poorer children are in our large cities. What an oasis in the desert is a clean house and person in our slums! What a blessing if school training will help to increase them!

Then, in my opinion, some special machinery for the direction and control of the sanitation of schools is needed. The Education Department, without aid from sanitary experts, is insufficient.

Perhaps with such aid it would be enough. Perhaps the creation of a Health Department in the Imperial Administration would solve the difficulty. But sanitary experts at the centre are not all that is needed. Every School Board should have its medical and sanitary adviser. For I am persuaded from personal knowledge that much good could be done by local sanitary experts in preventing disease among school children and in improving their health.

SUBSTITUTION OF A STANDARD OF SUPERFICIAL AREA FOR ONE OF CUBIC CAPACITY IN SMALL HOUSES.

By JOHN HONEYMAN, F.R.I.B.A.

The growth of sanitary law up to a certain point keeps pace with the growth of a community. We feel that while instinct may suffice for the individual, law is necessary as a social institution; and we willingly assent to such an amount of control, and such relinquishment of our individual freedom as the wellbeing of the community as a whole demands. But beyond a certain point the growth of sanitary law is not so much dependent on the growth of a community as on the growth of sanitary science; and sanitary science, or rather those who profess to be guided by it, seem to be developing a tendency to make on its behalf demands on the discretion of individuals which are not generally recognized as necessary. It would be easy to show that within the limit of justifiable interference sanitary law in no way conflicts with economic conditions. So long as we are content to compel the individual to do only what is universally recognized to be requisite for the wellbeing of the community, of which he forms a unit, we are on safe ground, and economic conditions will adjust themselves to the inevitable circumstances; but the moment we go beyond this, and compel individuals or sections of the community to do what we think, or even know, to be advantageous for other individuals or other sections of the community, or for themselves, we get entangled in complex economical difficulties which cannot possibly be ignored with impunity. For loss must occur where exaction is not balanced by compensation, and social-economic necessarily react on sanitary conditions.

For example, if a man earns 4d. an hour, and by working 10 hours a day makes 20s. a week, and you, with the best intentions, prohibit him from working more than 8 hours per day, your injudicious interference with his liberty will not affect his pocket merely, but also his health, and the health of those dependent on

him; for you at once reduce his income from 20s. to 16s. a week. If in addition to this you compel him to live in a house of such size, and fitted with such sanitary appliances that he cannot possibly get it without paying an additional 1s. a week of rent, you practically deprive the man of one-fourth of his total income, and to that serious extent reduce his ability to provide proper food and clothing for himself and his family. There is a popular delusion that legislation, which must bring about such results as these, is good for the working classes; but I have no hesitation in saying that that is an absolutely false idea. No legislation which disregards economic consequences can possibly be beneficial to the working classes, or conducive to the wellbeing of a community as a whole.

It is evident, then, that in all sanitary legislation we are bound to take this into account, and so to regulate our demands upon the common fund of individual right that we shall interfere as little as possible with the ordinary course of things, and with the freedom and responsibilities of individuals. Hence, in the matter with which we have now more particularly to deal—the securing of a certain amount of space for each occupant of a dwelling—we have to consider, first, what is the smallest amount of space which experience has proved to be sufficient under favourable conditions; and, second, how is that minimum of space to be secured for all members of the community with the smallest amount of interference with the interests of individuals. There are many sanitary reformers who aim at obtaining compulsorily what is desirable, rather than what is necessary, and I must say that I have no sympathy whatever with them. The desirable must be obtained by other means. Practically, the minimum will be largely exceeded, and the supply of the desirable will, without compulsion, follow the demand, without the drawback of economic disturbance; and therefore, in this matter of space, in fixing a compulsory minimum either by one standard or another, we must, as I have said, be content with the *smallest* amount which will serve our purpose. In the present instance it is exceedingly difficult to arrive at this amount, but as Parliament has within the last week determined that it should be 400 cubic feet, we may take that as an approximation to the space required in houses of the usual construction in Scotland. Assuming it to be so, then—although personally I don't admit it—we have next to consider the question, How is this to be secured on the most favourable terms? If there are several ways of doing it, and one is more favourable both to the owners and to the occupiers of houses than the others, we are bound to adopt that way, bearing in mind that preventible economic disturbance will always be most unfavourable to the very class we seek to benefit. I insist upon this the more because in much of our recent sanitary legislation it has not been sufficiently taken into account. There is a

growing tendency to ignore such considerations, and I avail myself of the opportunity of addressing such an influential body as this to direct special attention to their importance.

Hitherto there has been only one way of securing space for the occupants of houses—namely, by prescribing a certain number of cubic feet for each; and I desire to suggest another, which I hope to show you is in many respects preferable—namely, to prescribe a certain number of superficial feet of floor area.

The object of such specific rules, of course, is to prevent over-crowding, probably the worst of sanitary evils—an evil which is not by any means confined to our large cities, but one which our county councils must soon deal with as well as our civic authorities. It is not seriously contended by any one that 300 or even 500 cubic feet is enough for an adult, for say the working man's eight hours' sleep. Yet cases have been recorded in Glasgow where each adult had only 86 cubic feet. Now, it is evident that, whether 400 feet be a sufficient quantity or not, a house of 1,200 cubic feet capacity is much more likely to be a healthy dwelling if inhabited by only 3 adults, than if it is inhabited by 14; and the object of *a* standard is simply to give local authorities a ready means of effecting such a change. Overcrowding, in fact, must be dealt with summarily, by some rule of easy application. It is a nuisance which most directly affects the wellbeing of those who create it; but its evil effects are not confined to them. It must therefore be put down as a social offence; and this legal definition of space is merely an instrument to this end, perfectly serviceable if judiciously used; but inasmuch as the limitation is quite empirical, it is not judicious to apply the rule rigidly in all cases without regard to circumstances. It is reasonable that, in either case, as we have no exact scientific basis for our rule, we should allow it a little elasticity, and that we should adopt the rule which, even if rigidly enforced, would allow the greatest amount of freedom. Now, the chief merit of the rule I have suggested, as distinguished from the existing rule, is that it allows more freedom of action to those who have to turn expensive sites to account in providing dwellings for the poor. To that extent it is more beneficial to the poor on economic grounds, the importance of which I have already insisted upon. It would also give us more freedom in dealing with existing property—another gain to the poor in the same direction. Some people seem to think that you may, by harassing legislation, diminish the existing supply of houses, and hinder any prudent man from building new ones, without grievous injury to the poor themselves. If such persons are not guilty of such folly their conduct belies them, and is incomprehensible. You cannot, by these or by any other justifiable means, get for the poor more than they are able to pay for; and I was glad to hear that the Lord Provost of Perth, at all events, is not one of those foolish civic persons who seem to think

you can. Now, within moderate limits, you can give the poor superficial area easier than cubic capacity; you therefore, by following this course, make it easier to get a supply of houses for them; which means that rents will be easier even when sufficient inducement remains for builders to invest money in such property.

But the sanitary results would be even more important than the economic. You will at once see that, so far as the administration of the law is concerned, the change of standard would make no difference. It would be as easy for sanitary officials to apply the one as the other. The area would be a shade more easily got at than the capacity. The system of ticketing would remain as at present, and there would be no difficulty in dealing with the better class of workmen's house, as it will probably be necessary to do, in Glasgow at least, when their new Police Act comes into operation. The sanitary official's position, then, would remain unaffected.

Now, let me refer to the position of the occupants of houses affected by the rule:—(1) Their houses would be cheaper; (2) They would be larger and more comfortable; and (3) They would be more easily ventilated. These things, you observe, have all a direct bearing on health; they constitute, in fact, the most important factors in domestic sanitation—that is, so far as sanitation is dependent on the structure of the house—which is the only thing we are dealing with at present. Taking these things in the order stated, I must first go a little more exactly into the question of expense.

1. *Cheapness.* For the purpose of illustration and comparison, I shall take a tenement having on each floor three houses of one apartment and one of two apartments. If the single apartments are to accommodate 3 adults with 400 cubic feet each, they would require to be 10 feet high and to measure 12 feet by 10 feet, and the frontage of the tenement would be 35 feet and the depth 32 feet, and the site will extend to, say, 240 yards. Taking this as it stands, it is evident that if we are content with an area of 40 superficial feet per adult these houses would pass for 3 occupants either by the one standard or the other. But the difference is, that whereas by the new Glasgow standard of 400 cubic feet the tenement *must* have 10 feet ceilings, by the other the ceilings *might* be less. Suppose they were only 8 feet high the rooms would still have the cubic capacity which—up till last week—was generally considered enough as a minimum, namely, 300 feet. Now, I need hardly point out that if you reduced the ceilings to 8 feet, and so took 8 feet off the total height of the tenement, you would considerably reduce its cost. But if, instead of reducing the cost in that way, you prefer to keep the building the same height as the other, you could still more reduce the cost per house by gaining an additional storey; and you would at the same time thus be able to accommodate a larger population on the same

area. The height of ceiling suggested—8 feet—is quite sufficient for all practical purposes. Even in the excellent dwellings of the Peabody Trust no higher ceilings are allowed except sometimes on the street floor. But I am not so sure that the area of 40 feet is sufficient; what attention I have been able to give the subject leads me to the conclusion that we might venture to fix the minimum at 45 feet per adult. I think we may venture to go this length without throwing any additional burden upon the poor householder, and *that* we must regard as "the length of our tether." Of course, if we increase the area we require more ground; but generally, though not always, there need be no increase of frontage. For example, taking this same tenement erected on 240 yards of ground, the building would cover about 124 yards if made to the standard of 400 cubic feet; and 136 yards if made to the standard of 45 feet superficial, leaving sufficient free space behind. In most cases no increase of the site would be necessary, but in the calculations I have made I assume that it is required, and the following is the result :—The cost of the four storey tenement would be about £1,200, including ground at £1 per yard, and the cost of the five storey tenement would be about £1,300, including other 12 yards of ground at £1. Taking the rents at a low figure, say £5, 10s. for the single apartments, and £7, 10s. for the two-room houses, the rental of the four-storey tenement would be £96, or a gross return of 8 per cent; while the rental of the five-storey tenement would be £120, or a gross return of 9¼ per cent; so that if you chose to give the tenants the benefit of the saving, you could let them have the very superior houses in the five-storey tenement at 16s. *less* than the others, and yet have as good a return for your money. These houses would be slightly under the 400 cubic limit—but considerably over the 300 limit—their cubic capacity being 360. But, as I intend to show, they would be larger and better than those made to the full 400 standard. Before passing from the cost, however, I must point out how greatly the change I advocate would facilitate that perfectly legitimate form of quasi-philanthropic work which aims at providing the best possible accommodation at the cheapest rate consistent with commercial solvency. It is obvious that if the lowest limit you can come to is a gross return of 8 per cent (let us assume that it is), and if the best you can do for that sum under present restriction is to provide a house with all proper sanitary appliances, measuring 12 feet by 10 feet, your position would be greatly improved under the proposed rule; for, under it, you could offer a house measuring 12 feet by 11 feet 6 inches at 16s. less rent, and two ways of dealing with your surplus rental are open to you; either you may remit it, or you may use it to provide still better accommodation for poor people, without going beyond what we have assumed to be the practicable minimum under existing regulations. The

latter course is the one I am disposed to advocate, as it would effect immense improvement in the comfort of our smallest class houses. Starting from the same point as before the difference may be shortly illustrated thus. The tenement with houses 12 feet by 10 feet would cost, with ground at £1 per yard, £1,200, and yield 8 per cent gross, but without coming even so low as 8 per cent—keeping at least one-half to the good—the size of the houses could be increased to 13 feet 6 inches by 11 feet 6 inches—as the cost, including extra ground would be £1,385, and the rental, on the old basis, £120. Moreover, this enlarged tenement would accommodate other 4 families on the same ground; a sufficient margin over the 45 feet area would remain to warrant the intrusion for a time of one "little stranger" in each family; and the ideal of Dr. Russell and my other Glasgow friends—and, notwithstanding some difference, I will say, fellow-labourers—would be attained, as each house would have more than 400 cubic feet of capacity for each adult. I will only add here, and I ask your special attention to the assertion, that, under the rigid 400 cubic rule, these advantages and others which I have now to touch upon are unattainable, so long as authorities cling to the idea that houses must be 10 feet high.

2. *The houses would be larger and more comfortable.* After what I have just said, I need hardly insist upon the fact that the houses would be larger; but what does this mean in a poor household? It means a possibility of order, cleanliness, and general comfort, which hardly exists in our smaller houses, and which the cubic capacity rule cannot possibly secure. Suppose some one intended building our tenement under the old Glasgow rules—that is, allowing 300 cubic feet per adult—he would count upon having four adults in each single apartment; but the rule is changed, and if he still wishes to have a right to put four upon the same small area, all he has to do is to add a little to the height of his building and about 9 inches to the width of each room, and he is within the law—the room being then 12 feet by 10 feet 9 inches and 12 feet 6 inches high. I do not say that this would often be done—but it *might* be done—and in "made-down" houses, originally of a better class, it certainly would be done, and the Local Authority could not prevent it. Now, under the area rule, the floor of a house for four adults would have to measure 15 feet by 12 feet, whether the ceiling were high or low, the house new or old; and, among other incidental advantages of this expansion of area, the division of the house into separate apartments would necessarily, yet quite naturally, follow. Contrast, for a moment, a house measuring 12 feet by 10 feet 9 inches with one 15 feet by 12 feet, both occupied by (say) a man and his wife and four children. In the first the floor area is 129 feet. From this has to be deducted the space occupied by things which

ought to be in every house. These occupy an area of 87 feet, which leaves an area of free space, after gathering all the fragments together, of only 42 feet—little more than the area of a large bedstead. On this any chairs that are wanted must be placed, and here the children must disport themselves, while the father enjoys his pipe and the mother does her househould work! What wonder if the one gives up any attempt at tidiness in despair, even if the other makes a practice of clearing out of her way, as soon as his supper is finished, to finish his pipe in the public-house! On the other hand, if you make the same deduction for effects in the other house, there remains a free area of 93 feet—more than double the amount in the first—and you will readily conceive how much this facilitates a comfortable arrangement of "the things." As a test of the superiority of the larger house, I confidently ask you, gentlemen, to say which you would prefer for your own use. I think the advantages of elbow-room in a poor man's house have not been properly appreciated. Our authorities seek powers to secure for people a minimum height of ceiling of 10 feet and a cubic capacity of 400 feet, and yet apparently think it of no consequence whether or not these same people can find room in their houses for the most necessary bits of furniture and leave anything over for the "guidwife" to do "a han's turn" in.

But I must hasten, in conclusion, to refer briefly to the third point of superiority in houses of large area—viz., their healthfulness.

3. *They are more healthy.* You will admit that, if they can only be shown to be equally healthy, they ought to be preferred; but I can say they are more healthy. As I have gone into this part of my subject pretty fully on another occasion, in my paper on "The Advantages of Low Ceilings," published in the *Sanitary Journal*, and also in the *Transactions of the Sanitary Institute of Great Britain*, vol. v, p. 204, and therefore easily referred to, I shall not now go into the matter with any minuteness. The explanation of the chief source of its sanitary superiority is simply this—that inasmuch as the lower strata of air, in a house depending on its chimney for ventilation, are the purest, the more of these strata you can get into the house for the use of the inmates the better. Below the level of the fireplace lintel the air is always comparatively pure; between that point and the door lintel it is less pure; and above that point it becomes rapidly more and more foul as you ascend. Thus, if we say, for the sake of illustration, that the air up to the level of the fireplace lintel (say 3 feet 6 inches from the floor) contains 1 unit of impurity; the air for 3 feet above that 2 parts; the foot above that 3 parts; the next 4 parts, and so on, we shall have, roughly, this result: that, in the house for 4 adults, made in accordance with the existing practice, with 400 cubic feet per inmate, you will have 36 parts

of impurity—that is, 9 parts per individual—whereas, in the house made in accordance with the proposed standard, you would only have 9 parts of impurity altogether, or $2\frac{1}{4}$ to each inmate; or, taking it another way, it will be found that, whereas in the one house the total number of cubic feet of air under the fourth degree of impurity is 967, in the other it is 1,350. The balance of air in each case is practically of no use, but rather a source of danger, so that, in fact, it comes to this, that while in a house made strictly in accordance with the cubic capacity rule each inmate may only have 241 cubic feet of usable air, *and sometimes less*, in a house made in accordance with the proposed rule *no inmate can have less* than 337 cubic feet.

As I have already sufficiently taxed your patience, I shall merely enumerate a few subsidiary advantages peculiar to the large area house—(1) It would be more easily ventilated, for the larger the area the less need the inmates be exposed to draughts; (2) It would be more easily heated, and therefore, the inmates would be less likely to object to ventilation, if taught to value it, as we hope the working classes will soon be; and (3) The access would be easier and safer for children and old people, for no wheeling stairs would be required. These have all a very direct bearing on the sanitary wellbeing and comfort of the inmates; and, taken along with various other advantages I have enumerated, seem to constitute a strong case in favour of the change which I have ventured to propose, the merits of which you are so eminently qualified to appreciate and discuss.

THE VENTILATION OF SEWERS.

By J. D. WATSON, Assoc. M. Inst. C.E.,
Burgh Surveyor, Arbroath.

The necessity for ventilating public sewers has not yet been adequately recognised by many of the local authorities in Scotland. Sufficient importance has not been attached to the fact that a defective system of ventilation, as applied to sewers, is not only injurious in itself, but in a great measure it nullifies the hygienic advantages of an excellently designed and carefully constructed arrangement of house drainage. It is possible, no doubt, to carry into effect a system of house drainage which would completely isolate a building from the noxious gases of a foul and ill-ventilated sewer; but, in the present forward state of sanitary science, this should never be required. In the burghs, surveyors and sanitary inspectors are encouraging, and, in not a few instances, coaxing proprietors, not only to trap their private drains, but to ventilate them also; and local authorities should bear in mind that, unless in a few cases, there is no statutory power to cause proprietors to ventilate their drain-pipes; and, further, that it is only in the case of new buildings, or alterations of buildings, that the official has an opportunity of effecting this sanitary improvement. Old houses have no more than a drain trap to protect them from foul sewer gas, which is frequently inadequate; and to my knowledge there are many houses without even this protection. I have not found in Arbroath a single drain trap between a sewer and a dwelling house which was placed there prior to 1884.

It is not my intention to enter upon the controversial aspect of the question, whether sewer air *per se* is the cause of enteric fever or not, but I think all present will agree with me that there are many other diseases of which sewer gas may be productive besides enteric fever. Dr. Angus Smith said that "rather a wild clamour has taken place about sewers, and bad as their gases are, the

danger arising from them has been much exaggerated." This may be true, but we are all conscious of the fact that it requires a good deal of clamour to arouse local authorities and the general public to spend money in improving or constructing underground works; and it cannot be denied that the effect of breathing such air is to produce a state of *malaise*, and render those who breathe it less able to withstand an attack of disease.

I was instructed to prepare a report for the Local Authority of Arbroath, some months ago, upon the best mode of getting rid of the noxious effluvium emitted from many of the manhole surface boxes within the burgh; and, before reporting upon the subject, I communicated with and received replies from 55 towns' officials as to the methods adopted by them in ventilating the sewers under their charge.

To those replies I shall refer anon; meantime allow me to explain that the sewerage system of Arbroath consists of a network of F.C. pipes, from 10 to 15 inches diameter, led into a trunk sewer built of brick (egg-shaped), and which runs nearly parallel with, and at several places under, the bed of the Brothock Water, until it discharges itself into the German Ocean. The gradients to which the sewers have been laid are very good, seldom less than 1 in 36; and, generally speaking, they have been fairly well laid. Prior to 1884 the sewers were practically unventilated, inasmuch as all the gullies were trapped, and the manholes were protected by close fitting boxes, excepting in a few cases where box covers, in which there were a few square holes, $\frac{3}{4}$ by $\frac{3}{4}$ inch, were placed. These holes were so small, however, that they quickly got choked up with mud and small stones. The outflow pipe, or mouth of the trunk sewer which terminated the system at the seaside, was unprotected, so that the sea had free access to the sewers, and filled those lying in the lower portion of the town twice every day during the flow of the tide. I had the outflow pipe, which is 3 feet diameter, and made of cast iron, fitted with a self-acting flap-door, also made of cast iron, to keep out the rising tide; and had also adopted and fitted in about 30 ventilating manhole boxes, containing trays for catching road detritus, in various parts of the town, when I was instructed to prepare the report above referred to.

Of the 55 towns communicated with, 6 have no system of ventilation and 10 have only partially ventilated their sewers. In all the towns where ventilation has been appreciated the method which finds most favour is (1) to bring up a square shaft or manhole from the sewer and protect it at the street surface by a cast-iron box fitted with a lid partly open and partly close. This method, in its most approved form, has an entirely close cover fitted above the manhole shaft; alongside of this close cover an open ribbed grating is placed over a sand pit which is constructed about 18 inches apart from the manhole shaft, and

made to communicate with it so as to allow the noxious gases to pass freely into the air. The open grating above the catch pit, instead of the manhole shaft, safely guards the sewer from receiving road detritus. Forty of the towns communicated with have adopted this mode of ventilating their sewers in one form or another. (2) Eleven towns adopt the system of carrying open shafts up the sides of houses, &c. (3) Six towns have made connections to chimney stalks for the purpose of ventilating their sewers. (4) Five towns make use of the rain water conductors attached to buildings for a like purpose. (5) Two towns adopt the system of passing the foul air through charcoal placed in trays over the manholes. And (6) in Blackburn the sewers have been connected with special shafts for the purpose of conveying the sewer gas above the houses. I may mention that some of the towns are trying several of these methods.

Where so many systems of ventilation are in vogue, each system having ardent supporters of its own, it is essential to look narrowly into the merits and demerits of each.

The first (1) has hitherto found most favour amongst burgh engineers, chiefly for the reason that it is simple, and in its best form pretty effective, comparatively cheap, and easily carried out. It is not without its drawbacks, however, the principal one being the encouragement which is given for the emitting of sewer gas at places where people are constantly walking, and it is not always deemed a satisfactory answer to give the public that the gas has been so diluted with fresh air that it is quite innocuous.

(2) The special shaft system, when properly carried out, is quite as effective as the manhole system, and it has the additional advantage of carrying the disagreeable smells farther from our reach, but it has several very powerful defects, which, although not insuperable, weigh heavily with Local Authorities—viz., its great cost, the difficulty of getting shafts or pipes placed where they are most required for the proper working of the sewer, the difficulty of getting proprietors and occupiers to consent to their erection, their unsightliness when erected, and lastly, risk of leakage therefrom.

(3) The chimney stalk system has the advantage of creating a suction or exhaustion of air from the sewer, and of destroying foul air which is passed through the furnace, but fires are not always burning, and in many cases structural difficulties have to be overcome before it can be applied. Authority to make connections would require to be obtained from mill-owners, and this would be the more difficult, as there is an element of danger in such a connection.

Another defect, which would not be overlooked when the Local Authority is also the Gas Corporation, is that it hides from view and smell leakage from gas mains. I know of a case which

occurred in Arbroath some years ago, whereby a very large leakage of gas found its way into a disused mill chimney, and baffled the skill of the gas manager, assisted by a staff of workmen, to find it out for a considerable time. But, apart from these difficulties, I am satisfied that the benefit to be derived from connecting a sewer to a mill chimney is comparatively trifling.

While I write I have workmen making such a connection, but it is for the purpose of ventilating a sewer which is too near to dwelling houses to admit of the manhole being dealt with as above described; this connection is expected to do the work, which might be done by opening up the manhole cover, but no more.

In Paris and Antwerp shafts have been tried, but the results have not been sufficiently satisfactory to warrant an extension of the system. In the report of Sir J. W. Bazalgette, past President Inst. C.E., on the ventilation of sewers, written for the Metropolitan Board of Works in 1866, some valuable information on this subject is given. Sir Joseph says—"A furnace ventilating any large district would require to produce a very large volume of air, and to keep up a velocity sufficient to ventilate all the branch sewers, and the drag would consequently be so great through the main that it would force open any house drain traps or water traps we could form before it would influence the remote branches; but, putting these difficulties out of the question, which appeared to us insuperable, we found that the consumption of coal necessary to extract the required quantity of air, supposing that the sewers could be laid out like the channels of mines, would be something enormous." Mr. Henry Austin, C.E., the Consulting Engineer to the Commissioners of Sewers, in referring to the ventilation of the sewer in Friar Street, London (this sewer, I may mention, was connected with the furnace of a soap factory, and was unfortunately the scene of an explosion, caused by a jet of fire from the connecting pipe), said—"Further experience and consideration have led me to the conviction that whatever benefit, as in the case of Friar Street, might be derived from such a method of ventilation, even if it could practically be adopted as a system, the results would be far from satisfactory." I have referred to this matter at some length, for the reason that of all the proposals which are made for the better ventilation of sewers by those who experience the bad smells from manholes, this is the most general.

(4) This system is very economiçal in well populated districts, but it cannot be reckoned effective, inasmuch as it is inoperative at the very time when it is most needed. During a heavy rainfall very little, if any, ventilation can take place, as the conductors are thereby filled with rain, and there is no egress for the foul gas, which is more abundant at such a time than at any other. The

position of the outlets also is very objectionable—viz., immediately under attic windows.

(5) The charcoal system. In theory this plan looks very well, and suitable for the absorption of what may be regarded as the most dangerous matter present in sewer air; but in practice it is found that the charcoal cakes with damp, and it is rendered useless for absorbing fœtid organic vapour contained in the foul air of the sewer, and prevents air of every kind from getting to the atmosphere. It further requires constant attention and renewal.

In considering the various methods of ventilating sewers practised in other towns, in relation to what is most required in Arbroath, I kept before me the following five points, as stated by Mr. Baldwin Latham, C.E., viz. :—(1) That the system shall be simple in its operation and not likely to get out of order, and that it shall be independent of uncertain mechanical aid; (2) That it shall admit of the expulsion of all sewer air, and the supply of fresh air at all periods; (3) That the escaping gases shall be so diluted with atmospheric air as to be rendered harmless, or that they shall be destroyed or arrested; (4) That the system shall not impede natural ventilation; (5) That it shall not be costly in execution or maintenance.

I unhesitatingly recommended the Local Authority to continue and complete the system, which I had already begun, of opening all the manholes as described (1) and as shown on the plan submitted. I would also have recommended the untrapping of all the gullies, as in Glasgow, Dundee, &c., had our streets, and more particularly our foot pavements, been wider than they are. I may say that in coming to this decision I was very much influenced by the successful system of sewer ventilation which obtains in Dundee, under the charge of Mr. Mackison, F.R.I.B.A., a past president of this Association. Speaking of the chemical purity of the air present in Dundee sewers, Professor Carnelley, D.Sc., and Mr. Haldane, M.A., M.B., in a paper on the "Air of Sewers," given in the minutes of proceedings of the Royal Society, vol. 42, say—(1) "That the air of the sewers was much better than one might have expected; (2) that the carbonic acid was about twice, and the organic matter rather over three times, as great as in outside air at the same time, whereas the number of micro-organisms was less; (3) that in reference to the *quantity* of the three constituents named, the air of the sewers was in a very much better condition than that of naturally ventilated schools, and that, with the notable exception of organic matter, it had likewise the advantage over mechanically ventilated schools; (4) that the sewer air contained a much smaller number of micro-organisms than any class of house."

Along with my recommendation anent open manhole shafts, I pointed out to the Local Authority the imprudence of allowing

exhaust steam to be blown into the sewers. Recognizing the fact that the entrance of hot water and steam into sewers not only increases the pressure of sewer air, but also acts as a potent influence in the liberation of foul gases, many of the towns' authorities communicated with prohibit manufacturers and others from raising the temperature of the sewage by runing off hot water or blowing steam into the sewers; and when I mention that in some instances I have found the temperature of the sewage, as it passed certain manholes, to be as high as 98° Fahr., when the temperature of the external atmosphere was only 49° Fahr., you will agree with me that this is a direction in which there is room for improvement, and, as a frequent cause of creating foul gases, should be carefully dealt with.

Where the sewage of a town is emptied into the sea, or a tidal river, unventilated sewers are practically sealed twice per day, and the consequence of allowing heated water to enter sewers at such times is to unseal traps in the vicinity of the increased temperature owing to the expansion of sewer air. Assume, for example, the temperature of the air in the sewer to be 50° Fahr. when the hot water is admitted, and that it is raised to 130° Fahr.; when this is done the increased temperature would increase the pressure on the sewer pipe by 5·35 feet, which is a force no trap is expected to withstand. In making this calculation, I have employed the table given in Dr. Lardner's *Handbook of Natural Philosophy*, which shows the relative volumes of air at various temperatures. The volume of air at freezing point (32° Fahr.) is given at 1,000 cubic inches, and the pressure is inversely as the space occupied.

Vol. of air at 50° Fahr. is therefore = 1,036·7 cub. in.
Vol. of air at 130° Fahr. is therefore = 1,200 cub. in.

Let the original volume of air in the sewer at the temperature of 50° Fahr. be represented by O; volume of air after increase of temperature by I; atmospheric pressure equal to a column of water 34 feet in height by A; and the pressure after the increase of temperature by X, and you have the formula—

$$O : I :: A : X \text{ or } 1{,}036{\cdot}7 : 1{,}200 :: 34 : X = 39{\cdot}35$$

showing an increase of temperature after the addition of the volume of hot water equal to 5·35 feet.

In 1858 the Surveyor to the City of London (Colonel Haywood, C.E.) compiled a statement showing the average temperature of the sewers under his charge, as compared with the external atmosphere in shade. This state showed the average for the year to be 5·11° Fahr. higher in the former case as compared with the latter. In the summer months the average temperature of the

sewers was below that of the atmosphere. In spring the temperature of both was equal, while in autumn and winter the temperature of the atmosphere was under the temperature of the sewers." The foregoing statement of course applies to sewers where there is a large flow of liquid sewage, and may be taken as comparatively true of such cities as Edinburgh, Glasgow, and Dundee, where the water supplied to the inhabitants amounts to about 50 gallons per day, per head; but it does not bear the same resemblance to sewers in Arbroath where the water supply only amounts to 7 gallons per head per day.

For the purpose of ascertaining accurately the actual quantity of water which finds its way to the sewers from an ordinary dwelling house, as compared with the quantity actually taken into it, I made careful observations on one street of Arbroath, which consists exclusively of artisans dwellings, and I found that the waste water measured at the manhole at the end of the street amounted to 3 gallons per day of 24 hours per head, and the water supplied to the street as registered by a water meter fixed to the main amounted to 4·05 gallons per day per head. To this quantity of water there should, however, be added, say 2 gallons per head in name of rain water drawn from store cisterns or barrels. It should be stated that there is only one water-closet connected with the drains which lead into this sewer. The temperature of sewers of a manufacturing town where the water supply is very limited is bound to be higher than it would be if there was a large quantity of cold water being poured into them, because the hot water and exhaust steam which constantly find their way into the sewers increase the temperature of sewage and sewer air much more readily than if the proportion of cold water to be heated was much greater in quantity. It may be taken therefore that heat is comparatively more powerful in sewers which convey small quantities of waste water.

I further recommended the Local Authority to carry out their outfall sewer to low water level (it is 6 feet above that level at present) and to renew the self acting flap-door which was broken by a storm, as I am persuaded that there is nothing more productive of foul gases within sewers than to allow the sea to fill up long lines of sewer pipes for several hours every day. Even when we are quite successful in excluding sea water from a system of sewers, we have to combat the natural effect which the ebb and flow of the sewage has in producing vapour and sewer gas by leaving the sides of the sewer alternately wet and dry—a cause of itself sufficient, in the estimation of Mr. Latham, to render a system of ventilation absolutely necessary.

Allow me to mention one other very common practice which is responsible for the generation of noxious gases and the dissemination of micro-organisms in sewer air—that is, forming drain

connections to the roofs of sewers, and the introduction of surface water into sewers from gully gratings, by pipes placed almost vertically from the top of the sewer. Every connection to a public sewer should be made at the level of the sewer itself, and so as to join it at an oblique angle following the direction of the flowing sewage. In this way waste water and sewage is made to unite with the main flow without splashing or perturbation. This rule, although observed in several towns where sanitary science is well advanced, is still very much disregarded and undervalued. In support of what I desiderate, the following quotation, from the excellent paper already referred to, by Professor Carnelley and Mr. Haldane, emphasises the important bearing which splashing has upon the generation of micro-organisms—viz., "In Dundee and at Westminster a large proportion of the drains were found to enter the sewers through the roof. This gave rise to a considerable amount of splashing, the effect of which on the dissemination of micro-organisms in the air it seemed very important to investigate." They further go on to say that "an analysis was made within about 2 feet of a shower of water proceeding from the roof of the Dock Street sewer, the draught being very slight. The number of micro-organisms present was 103 (all bacteria); an analysis made shortly afterwards a few feet to windward of the shower of water gave only 12 micro-organisms."

During one of the analyses made at Westminster, a sudden and very violent shower of sewage occurred about 10 feet to windward of the tripod conveying the Hesses tube. In this case the number found was 25 (all bacteria), whereas, an analysis made at the same point a few minutes later, after the dripping had ceased, gave only 8 micro-organisms. These gentlemen go on to say—"From the foregoing observations, it appears that micro-organisms are undoubtedly disseminated in sewer air by splashing, but whether they are carried far in the air cannot be decided from the above experiments. The point is one of great practical importance, as the micro-organisms in question are those on which most suspicion of properties injurious to health naturally falls."

To elucidate this matter more clearly, Professor Carnelley and Mr. Haldane instituted a series of experiments which brought out some remarkable facts, most valuable to the sanitarian, and they say, regarding these experiments, that the results are very decided, and confirm and extend the results obtained by Professor Frankland from lithia solutions. They show conclusively not only that micro-organisms are disseminated in sewer air by splashing, but that those having this origin may be carried to a considerable distance along a sewer or drain pipe. Calculating from these experiments, air vitiated as above described, and to

a similar extent, would still contain about 400 micro-organisms per litre, after travelling 60 yards in a sewer 5 feet high and with a draught of about 1 foot per second. It is therefore of the greatest importance that sewers and drains should be so arranged as to avoid splashing as much as possible. There are other phases of this question of sewer ventilation which might be considered, but I have dealt with those which appeared to me to demand most attention in dealing with the question of ventilating the sewers of Arbroath.

DEFECTS IN THE "PUBLIC HEALTH (SCOTLAND) ACT, 1867."

By GEORGE M'KAY,
Sanitary Inspector for the Burgh of Govan.

Prior to the passing of "The Public Health (Scotland) Act, 1867," the sanitary legislation which was generally applicable to the whole of Scotland was to be found in the provisions of "The Nuisance Removal (Scotland) Act, 1856." The first general legislative recognition, however, which Parliament gave to Public Health was as far back as 1846, which was a temporary Act. It was followed by a permanent Act, entitled "The Nuisance Removal Act, 1848." This Act applied to England, Scotland, and Ireland, but the first Public Health Act, which Scotland alone was honoured with, was "The Nuisance Removal (Scotland) Act, 1856," which applied to the whole country, urban and rural. After this we had "The General Police and Improvement (Scotland) Act, 1862," which contained provisions regulating the cleansing and paving of towns and populous places, and certain amendments upon the Act of 1856. It was, however, found by practical experience that the sanitary laws of the country were still defective, and in 1867 the then Lord-Advocate Patton, at the instance of the Board of Supervision, requested Mr. George Munro, a distinguished lawyer in Edinburgh, to frame a new Public Health Bill, and in the session of Parliament of that year Lord-Advocate Gordon piloted through this Bill, which received the Royal assent on the 15th of August, 1867, and is applicable to both urban and rural districts. While a good many of the provisions of this Act were new, it also contained the leading sections of various other Acts, and repealed "The Nuisance Removal (Scotland) Act, 1856," "The Sewage Utilization Act of

1865," "The Sanitary Act of 1866," and Sections 441 to 447, both inclusive, of "The General Police Act of 1862." This Public Health Act is decidedly a great improvement on the whole of its predecessors—in a sense consolidates all the other Acts—and is the last and only general Act which at present applies to the whole of Scotland. But since 1867, Dundee, Aberdeen, Greenock, and Edinburgh have acquired local Police Acts of their own, incorporating some new and excellent provisions regarding sanitary operations, which have armed these populous places with greater powers and advantages not enjoyed by other less favoured urban centres; and hence the indifference manifested by the former in desiring any change in the existing law.

Since the adoption of "The Public Health Act," a very great and, happily, beneficial change has taken place in the health of Scotland, especially in the large and principal towns where its provisions have been honestly applied by intelligent Local Authorities and officials. Not only has the general death-rate been reduced, but deaths from the infectious or zymotic group have suffered a very large reduction indeed. This remark is particularly true as regards large urban communities, while the rural death-rates remain as before, and in some cases have absolutely increased. It is a fact that certain large urban centres, which formerly showed a very heavy mortality per 1,000 of the population—even double the rates obtained in country parishes—are now in the proud position of showing an annual death-rate which is very much below that of a great many of our quiet country districts. There is no doubt that the application of the Act has conferred great benefits upon the community, but a great deal more might and should be done were its provisions further extended, and more defined and specific. In other words, the Act, excellent as it is, contains a great many defects which ought now to be remedied after 23 years' practical experience of its provisions. In the preface to the first edition of the Act, Mr. Munro, its author, guards himself by stating that "from the varied and progressive nature of sanitary science, it is not possible that any measure on the subject of public health can be complete or final." Well, gentlemen, it may be admitted that the science of public health is now practically beginning to be known, yet years must elapse before the tardy growth of knowledge in this direction can come to a tangible maturity; but while that is so, the amount of knowledge gained in this science within the last 23 years is very much in advance of that possessed in the year 1867 when the Public Health Act became law, and is undoubtedly very much in advance of our legislative enactments. Hence arises the difficulty experienced in the practical application of this knowledge to the removal of certain elements, which are now known to be hindrances to the advancement of public health.

As already stated, not only have the leading Scotch towns provided themselves with new and enlarged powers since 1867; we also find that England has acquired an amended Public Health Act in 1875, and Ireland in 1878, each of which contains provisions that are very much in advance of ours, and admit of certain matters being dealt with which cannot be interfered with under our Act. I shall now endeavour to specify some of the leading defects of the Act—in other words, enumerate a number of defects which are more or less associated with certain of its sections or clauses.

Well, then, in dealing with a nuisance we find from the definition given in the Act that it is extremely difficult to prove it in a court of law, as "injury to health" must be shown. This is certainly one of the greatest obstacles preventing the Act from being practically applied to a great variety of nuisances. The whole question resolves itself into one of opinion which must be sworn to. It ought to be sufficient for the subjects enumerated under Section 16 to be proved either foul and offensive, or that they are in such a condition as to prevent the fulfilment or proper use to which they are really designed without necessarily proving injury to health. There does not appear to be any definition given in Section 3 to such terms as "Drain," "Sewer," "Street," or "Sanitary Inspector." Then in Section 17 we find the so-called power of admission to premises by the members of Local Authorities or their Sanitary Inspector extremely weak. In the first place, admission is requested, which may be refused, and no penal consequences follow such refusal. Then the Local Authority or Sanitary Inspector may apply to a Sheriff or Magistrate and give sworn evidence that he believes a nuisance exists on certain premises, upon which an order may be issued to the occupier to admit. He may still refuse, but on this occasion a £5 penalty follows, and only after these formalities are gone through a warrant may be issued for forcible entry. Why should not an equal power be conferred on the Sanitary Inspector in this respect as is given to an Inspector of Factories or that of the Police and Sanitary Inspector under the Glasgow Act of 1866? The Act contains no power to impose any penalty on the author of a nuisance who fails to carry out the terms of a notice issued by the Sanitary Inspector; indeed there is no power even given to the Sanitary Inspector to send any notice at all. Although a notice is invariably given, a penalty only follows after contravention of decree or interdict and a sum not to exceed ten shillings for every day of such contravention is held sufficient. I hold that foul and really offensive nuisances, which are considered to be so by the Medical Officer or Sanitary Inspector, ought to be removed at the instance of the inspector on the failure of the owner to comply with the terms of the first notice, and thereafter that the author

should be charged with the expense, as is done by the Burgh Surveyors, under the provisions of the General Police Act, in the case of foot-pavements, streets, &c.

Section 26 is no doubt very good as far as it goes, but it gives no power to seize eggs, meal, flour, or tainted or rancid butter which may be unfit for human food. In Section 30, before the words "injury to health," should be added the word "offensive," as any trade that is not specifically mentioned might require to be proved injurious to health. This Section does not provide for the erection of a public slaughter house. This matter, like a great many others, is left in the hands of the Police Commissioners under the General Police Act of 1862. In Section 39 there is no power given to a Local Authority to construct an hospital beyond its own municipal limits. This can only be done in the case of a combined hospital.* Then as to removal to hospital, it appears, according to the literal wording of Section 42, that compulsory removal can only take place if there is no proper lodging or accommodation, or if the patient be lodged in a room occupied by others besides those in attendance on such patient. Now it might legally be held that provided the householder was able to give proper medical attendance and nursing, typhus, small-pox or cholera could be treated in the kitchen of a "room and kitchen" house on the allegation that the members of the family were kept in the room; or he may have them removed out of the infected room to another house provided by the Local Authority—possibly in the same tenement for that matter of it—as a Reception House is not specifically mentioned, although possibly implied. Now this way of retaining dangerous diseases, such as those mentioned, in a room and kitchen house in a common tenement, where there may be from two to nine or even a dozen tenants on each stairhead, is simply courting the spreading of disease. I hold that in such circumstances there ought to be absolute compulsory power invested in the Local Authority to remove all infectious cases from every house which at least does not contain more than two apartments.

We come now to the question of the disinfection of house and clothing. The law in this respect is also very weak, as Section 40 does not authorise a Local Authority to provide special vans and remove infected clothing, but, curiously, power is given by implication to any person to bring or carry such infected clothing to a place for disinfection; but as to the cleansing and disinfection of an infected house or articles therein likely to retain infection, the extraordinary procedure of obtaining a medical certificate for such a purpose must first be gone through, and the Sanitary Inspector must be generally or specially authorised by the Local Authority

* This is now conceded by the Legislature by an Act passed in the present session of Parliament.

before he proceeds further in the matter, and then not be able to get it done by a staff for the purpose, but send a notice requesting the occupier or owner to clean and disinfect the same. Now these are matters which should be done by the Local Authority without the production of any medical certificate and without any payment whatever, as such operations are decidedly for the general protection and good of the whole community. In all the principal and large towns of Scotland all these things are done by the respective Local Authorities at the expense of the public, and the owners and occupiers are never, as far as I know, requested to interfere in the matter; and for good reasons, as, in the first place, a great many of them would not know how to disinfect either their house or their clothing. Secondly, it would not be prudent to let them do it in any case, as injury might follow; and a Local Authority which, after notice is served upon the householder or owner, depends upon proper disinfection being carried out by the party himself, is, I am afraid, reposing in a false security, as the Act does not provide that it should be done to the satisfaction of anybody, and if the owner or householder states that it has been done, the Sanitary Inspector is helpless.

In Section 44 we find that no power is given for separating the sexes in houses let in lodgings, as is given in the case of common lodging houses. Sections 48 and 49 do not prevent any person suffering from an infectious disease from entering any public or private conveyance, provided such person intimates to the driver or person in charge that he or she is then suffering from disease; and even then the person in charge of the conveyance is at liberty, though not bound, to carry the infected person provided the conveyance is disinfected thereafter. No power is given for the compulsory application of the smoke test, and there is no reference whatever to the adoption of any particular system of drainage or plumbing to either houses or tenements. No doubt Section 75 empowers the Local Authority to enter and lay open any land or premises for certain purposes, but does not specifically refer to the testing of drainage. Great powers are given to a burgh surveyor to enter premises in Section 207 of the General Police Act, and to the Sanitary Inspector under the Irish Public Health Act of 1878. Then as to the water supply, there does not seem to be any power given in Section 88 for water to be placed in every house in burghs having a population of 10,000 or above, but, curiously, in Section 89 this power is given in burghs having less than 10,000. Section 210, however, of the General Police Act, 1862, provides for water being carried into every house.

The following are matters which are not provided for in our public health legislation, no reference being made to them from the one end of the Public Health Act to the other. No power is given for either a medical or a veterinary examination of

cattle supposed to be affected with tuberculosis, scarlet fever, or diphtheria, nor can the Local Authority enforce the construction of private washing-houses for a house or tenement. The Act does not state what is a suitable water-closet accommodation; whether it may be a closet for each house or a hundred houses. No power is given to obtain water supply direct from the main instead of from the cistern. Any owner of a tenement consisting of double or more apartment houses can subdivide the same even into single apartment houses, and there is no provision in the Act to prevent him or ordain him to apprise the sanitary authority or lay plans before the Dean of Guild Court. There is likewise no specific provision against a tenant using a washing-house attached to a tenement for the purpose of washing his infected clothing, neither is there anything to prevent a teacher from receiving into his school children from an infected family, nor to prevent the parent from sending such children to school. A Local Authority is not empowered to afford such medical attendance and nursing as may be considered necessary to a fever patient dependent on an able-bodied man who may be denied parochial relief. No reference is made to the emptying of ashpits, nor the cleansing of streets or back courts, and no power is given against removal from one locality to another, in a public conveyance, of the remains of a person who died of an infectious disease. Neither does the Act contain any provision whereby a sanitary authority may be recouped for extraordinary expenses incurred in the treatment and management of infectious disease brought by ships from foreign ports. A matter which is common amongst the poor, is to hold a wake in small houses over the body of a person who died of fever, and there is nothing in the Act to prevent it. There is no power given to an inspector to go from house to house to discover nuisances, and in the event of a dirty house being found having a close filthy smell, which emanates from dirty bed or body clothing or any other matter, there is no specific power whatever given to deal with it. There is no power given to a Local Authority to prevent overcrowding by ticketing in small houses other than those where lodgers are retained. Then there is no reference to the cubic capacity which ought to be given to an adult or a juvenile in a sleeping apartment, nor any power in dealing with what might be considered an overcrowded, dilapidated, and generally insanitary tenement, either as regards its improvement or total demolition. Another very important matter is excluded, namely, the construction and design of tenements as regards their height, breadth of streets, size of house, situation of closet, &c. Nor is there any power given to inspect and test new premises prior to their occupation by the tenants. Then as regards the sale and distribution of milk, the Act is absolutely silent upon the subject, and we have to go and

seek such redress as can be given in the provisions of the Dairies Order of 1885 which are extremely defective of themselves, but as this formed the subject of a special memorandum by me in the month of February, 1889, I need not presently dilate further upon the subject, than merely state that power should be given to urban authorities to inspect and examine dairies and milkshops in any place situated beyond their municipal limits, and to prohibit the sale or distribution of milk within their own bounds on the production of a medical certificate that infectious disease exists in either the cattle or the dairyman's premises; that, on the fact of a case of fever becoming known to a rural sanitary inspector as existing in a farm, notice of this should be communicated to the inspector into whose district the milk from the farm is sent; and that power be given to a Local Authority to compulsorily remove an infectious patient from the milkman's private house or registered premises.

Such, then, gentlemen, are some of the defects which are to be met with in applying the provisions of our "Public Health Act" to actual practice. No doubt there are a great many others, but these are of a minor or more detailed character, and would take a couple of hours to enumerate. I have studiously avoided referring to the defects pointed out in the extremely valuable publication which has just been issued from the pen of Dr. Skelton, the worthy secretary of the Board of Supervision. The sanitary inspector who really wants to put himself in possession of all the leading Acts of Parliament which bear upon his official duties, would require to obtain and study the provisions of the "Public Health Act" itself; "Artizans' Dwellings Acts, 1875 and 1885;" "Factory and Workshop Acts, 1878 and 1883;" "Cattle Sheds in Burghs Act, 1866;" "Contagious Diseases (Animals) Acts, 1878 and 1886;" "Dairies, Cowsheds, and Milkshops Orders, 1885 and 1887;" "Infectious Disease (Noticfiation) Act, 1889;" "Margarine Act, 1887;" "Rivers Pollution Act, 1876;" "Sale of Horse Flesh Act, 1889;" "Sale of Food and Drugs Acts, 1875 and 1879;" "Smoke Acts, 1857, 1861, and 1865;" "The Burial Grounds Act, 1855;" "The Quarantine Act, 1825;" and last, but not least, the sanitary provisions which are to be found buried in or sandwiched between the clauses of the "General Police Act, 1862." Like our friend, the Public Health Act, it must be confessed that there is not one of these Acts but could stand more or less material revision in order to bring them into harmony with the practical experience gained since they received the Royal assent. Now, what I think ought to be done with all these legislative enactments which really bear directly upon sanitation, is to consolidate the whole of them into one general Public Health Bill which would contain clauses embodying the subjects I have endeavoured to point out, and

have this Public Health Bill framed in such a manner as to make it applicable to both urban and rural communities. As to who should prepare this Bill, I think that is a matter which may very safely be left in the hands of the Board of Supervision and the Lord Advocate, or the Secretary of State for Scotland. By such an Act Local Authorities would be invested with new and enlarged powers, which would enable them efficiently to deal with nuisances and diseases which are a danger and menace to society; and the constant and intelligent application of such powers would, I have no doubt, in due time indicate results which would be for the general benefit of the community at large.

APPENDIX.

I. ANNUAL MEETING AT PERTH.

II. THE SECRETARY'S REPORT.

I.

ANNUAL MEETING AT PERTH.

The Sixteenth Annual Congress of the Sanitary Association of Scotland was opened on the 23rd July by Dr. Cameron, M.P. The meeting was held in the hall of the Police Commissioners, in High Street, and there was a large attendance of members, among others present being Lord Provost Whittet, Perth; Mr. Robert Pullar, Tayside; Bailies Wilson, Moir, Jackson, and Bridges, Perth; Professor Ebenezer Duncan, Glasgow; Professor Christie, Hillhead; Mr. John Honeyman, architect, Glasgow; Professor Matthew Hay, Aberdeen; Mr. Andrew Heiton, architect, Perth; Councillors Maconnachie and Anderson, Aberdeen; Dr. Nasmyth, Cowdenbeath; Mr. J. D. Watson, surveyor, Arbroath; Mr. George Mackay, Govan; Mr. G. A. D. Mackay, Edinburgh; Mr. John Macdonald, Hawick; Bailie Hogg, Hawick; Mr. James Marshall, Falkirk; Dean of Guild Pirrie, Perth; Mr. Thomas Jackson, Moderator of Perth High Constables; Mr. John Thomas, Sheriff-Clerk of Perthshire; Mr. Daniel M'Kenzie, Chairman of Perth School Board; Dr. Alex. Simpson, Perth; Mr. John Welsh, Perth, &c.

At the business meeting, which was held in private, the office-bearers were appointed as follows:—*President*—Mr. Peter Fyfe, Glasgow. *Vice-Presidents*—Mr. G. A. D. Mackay, Edinburgh; Mr. K. Cameron, Aberdeen; Dr. Christie, Hillhead; Dr. Duncan, Crosshill. *Secretary and Treasurer*—Mr. J. C. Stobo, Rutherglen. The Council was appointed as follows:—*Medical Officers*—Dr. Christie, Hillhead; Dr. M'Vail, Kilmarnock; Dr. Littlejohn, Edinburgh; Dr. Caldwell Smith, Motherwell; Dr. Macdonald, Beith; and Dr. Nasmyth, Cowdenbeath. *Sanitary Inspectors*—Mr. Geo. Mackay, Govan; Mr. A. S. Edmiston, Rutherglen; Mr. Wm. Neilson, Falkirk; Mr. Wm. Cameron, Broughty-Ferry; Mr. Duncan Neil, Arbroath; and Mr. Thomas Simpson, Hillhead. *Architects and Surveyors*—Mr. Wm. Mackison, Dundee; Mr. John Honeyman, Glasgow; Mr. Joseph Potts, Partick; Mr.

Alex. J. Turnbull, Greenock; Mr. Neil Gillies, Lochgilphead; Mr. J. D. Watson, Arbroath.

The members afterwards adjourned for luncheon.

The public proceedings of the Congress were formally opened at one o'clock. Dr. Cameron, M.P., took the chair, and was supported by Lord Provost Whittet, Dean of Guild Pirrie, Bailies Jackson and Moir, and Mr. Robert Pullar, Tayside.

Lord Provost Whittet cordially welcomed the members of the Association to the city of Perth. He did so with greater pleasure because he believed their own respected sanitary inspector, Mr. Welsh, was one of the first to initiate the Association which had done so much for the benefit of the people of Scotland in the past, and which, as scientific knowledge increased, would be productive of still greater benefit. He did not think the sanitary inspectors failed in the slightest degree in performing the duties expected of them, but the people themselves were rather remiss in observing the conditions necessary to health. The people must be educated up to the fact that they could to a large extent assist local authorities in maintaining good sanitation.

Dr. Cameron, M.P., President of the Association, delivered the opening Address on "The Economy of Thoroughly Efficient Sanitation."

Dr. Matthew Hay, Professor of Medical Jurisprudence, Aberdeen University, read a paper on "The Vital Statistics of Children of the School Age in Scotland"; and Dr. Eben. Duncan, Professor of Medical Jurisprudence, Anderson's College Medical School, Glasgow, on "Adulteration of Food."

In the afternoon the members dined together in the Salutation Hotel. There were upwards of 70 delegates present. The chair was occupied by Dr. Cameron, the president, who was supported on the right by Lord Provost Whittet, Bailie Wilson, and ex-Dean of Guild M'Kenzie; and on the left by Mr. Robert Pullar (of Tayside), Bailie Jackson, and Professor Matthew Hay. Professor Hay, after the loyal and patriotic toasts had been drunk, proposed "The Lord Provost, Magistrates, and Town Council of Perth," to which Lord Provost Whittet responded. Bailie Jackson, Perth, proposed the toast of "The Sanitary Association of Scotland," referring to its work as noble and patriotic. He knew of no combination of men in this age more fitted to do good than the Sanitary Association of Scotland. Mr. John Welsh, Perth, acknowledged. A number of other toasts followed.

On Thursday, the 24th, Dr. Cameron, M.P., again occupied the chair, and the following papers were read and discussed:—"The Substitution of a Standard of Superficial Area for one of Cubic Capacity in Small Houses," by Mr. John Honeyman, architect, Glasgow; "Micro-Organisms in Air, Water, Food, and Soils, in Relation to Infectious Diseases," by Dr. Thomas G. Nasmyth, Cowdenbeath; "Defects in the Public Health (Scotland) Act,

1867," by Mr. George Mackay, sanitary inspector for the burgh of Govan. Dr. Christie, Lecturer on Hygiene and Public Health, Anderson's College Medical School, Glasgow, then opened a discussion on "The Powers and Duties of County Councils and District Committees under the Sanitary Clauses of the Local Government (Scotland) Act." Several members took part in the discussion which followed. The concluding paper, on "The Ventilation of Sewers," was then read by Mr. J. D. Watson, Surveyor, Arbroath.

After the discussion on this paper, Dr. Simpson moved the following resolution :—"That the Sanitary Association for Scotland, having had under its consideration defects in the Public Health (Scotland) Act, resolve that a memorial be framed urging upon the Secretary for Scotland the propriety of formulating a new and enlarged draft Health Bill for Scotland, and of introducing it as early as possible into Parliament."

Mr. Stobo, the secretary, seconded the resolution; but, after a short discussion, the resolution was withdrawn, the question being remitted to the Council for consideration and report.

The business of the Congress was then closed. Before the members separated they appointed Dr. Cameron to be honorary president of the Association; and voted thanks to the Corporation of Perth for their reception of the Association, and to Dr. Cameron for his services as chairman.

The meetings of the Association were, on both days, largely attended: the papers read were of an unusually high order; and the discussions relative thereto evinced the interest taken by the delegates in the various subjects discussed. The meeting at Perth was one of the most successful which has been held. It was arranged at the business meeting that the next Congress be held at the city of Edinburgh, in September, 1891.

II.

THE SECRETARY'S REPORT.

At the Sanitary Congress held at Perth, Mr. J. C. Stobo, Rutherglen, Secretary, read the following report on the work overtaken by the Association :—

In presenting you with the Sixteenth Annual Report, I will refer to the formation of the Association 16 years ago. It was established on the 20th day of January, 1875. It was composed of sanitary inspectors only, whose names and appointments had been duly notified to the Secretary of the Board of Supervision. It was named the "Sanitary Inspectors' Association of Scotland." The conveners of health committees in burghs, and chairmen of local authorities in rural districts, whose sanitary inspectors were members of the Association, were honorary members in virtue of their offices. The credit of the origin of the Association belongs to our esteemed friend, Mr. Welsh, the Sanitary Inspector of Perth, who is here to-day. The first meeting was held in Stirling. Thirty-one members attended that meeting, and chose for their President the late Mr. K. Macleod, Sanitary Inspector of Glasgow.

The chief objects the Association then had in view, as set forth in their first resolution, were—the mutual consideration of subjects connected with sanitary matters; the diffusion of information which would lead to an increased knowledge of the laws of health and of sanitary matters generally; the establishment of a proper system of co-operation and communication between sanitary officials throughout Scotland; and the affording of cordial aid to each other in all matters appertaining to the discharge of the important duties of the office of sanitary inspector.

An Executive Committee, afterwards called a Council, of 18 members, in addition to the president, vice-president, and secretary, who has always been treasurer as well, was appointed to conduct the business of the Association. At first they met monthly, issued circulars anent infectious diseases, considered the

bills brought before Parliament on public health, discussed the best means of dealing with the various nuisances, and acted as a "bureau" of information relating to all matters in any way connected with the health of the people.

The Association had from the beginning to contend with the difficulty of frequently bringing together officials from all parts of Scotland, who could spare neither the time nor money necessary for the accomplishment of the ends they had in view. To obviate this difficulty, it was remitted to a committee to consider the desirability of getting a monthly *Sanitary Journal* for Scotland established. The result was that a Scottish Sanitary Journal Company (Limited) was formed. Capital £500, divided into 2,000 shares of 5s. each, the shares being allocated to members of the Association only. The journal was to cost 6d. monthly, the first number to be issued on 1st March, 1876. Dr. Dougall, Glasgow, editor, and Mr. Miller, Trongate, Glasgow, printer and publisher. At the end of three months Dr. Dougall gave up his position as editor. On 6th July, 1876, the editorial committee reported that they had secured the services of Dr. James Christie, who has so ably and successfully conducted the *Sanitary Journal* from that day till now, with Mr. Alexander Macdougall, Glasgow, printer and publisher.

The next progressive movement was made by Mr. Welsh, to open the doors of the Association to medical officers of health, and all others who took an interest in sanitary matters. He gave notice of that motion in 1876. It took him 2 years to carry his point, but at last, on the 26th day of June, 1878, his motion was carried unanimously: that the name be changed from the "Sanitary Inspectors' Association for Scotland" to that which it now bears—viz., the "Sanitary Association of Scotland," proving that, after all, there is a great deal in a name. It may be interesting here to note that the first medical man who joined the Association was Dr. Christie.

In 1880 a question of great importance was brought under the notice of the Association—viz., the formation of district associations, subordinate to the national one. A great deal of attention has been paid to this subject, but its realization has been left to the council you will this day elect, who, I am sure, like the councils of the past, will do all in their power to carry to a successful issue whatever instructions you may be pleased to give them.

Another question of still greater importance was raised at the annual meeting in 1882—viz., when it was proposed that the Association should enter into negotiations with the Sanitary Institute of Great Britain, with the view to affiliation. After a lengthened correspondence, the terms which the English Institute offered were considered unsatisfactory, and the negotiations were broken off. The object aimed at in the negotiations, however,

was not lost sight of, which was that sanitary inspectors in Scotland might have the advantage of examinations in sanitary science, such as the British Institute were providing for surveyors and sanitary inspectors in England. At the annual meeting in 1884, which took place in this hall in which we are now assembled, it was remitted to the executive to take into consideration the desirability of instituting examinations in sanitary science in connection with our own Association.

The proposal was allowed to stand over for a while till the Local Government (Scotland) Act came into view, making it compulsory on County Councils to appoint experienced sanitarians as health officers. Provision had already been made for granting diplomas in sanitary science to medical men; but there was no institution in Scotland to certify that any non-medical man knew anything whatever of the multifarious duties developing upon the office of sanitary inspector. In these circumstances you felt called upon to supply the want that was so urgently required.

Accordingly, at our last Congress, which was held at Inverness in July last year, a special committee was appointed to consider the desirability of the Association holding periodical examinations in sanitary science, for the purpose of granting certificates of competency for the office of sanitary inspector. This brings us to the work done during the past twelve months.

A meeting of this committee was held on 29th August, when it was resolved that, in order to advance sanitary science in Scotland, and to enhance the value of certificates of competency granted by this Association to sanitary inspectors, the examination papers and oral questions put to candidates shall be of a higher order and more searching nature than have hitherto been demanded by such Examining Boards. It was then proposed and unanimously agreed to that a Board of Examiners be appointed, who shall have charge of all matters connected with the conducting of examinations, including the appointment of examiners, who may or may not be members of the Board, the Board to consist of the following gentlemen:—Dr. J. B. Russell, Glasgow; Dr. Christie, Hillhead; Dr. Hay, Aberdeen; Dr. Littlejohn Edinburgh; Dr. Smith, Motherwell; Dr. Wallace, Greenock; Dr. M'Vail, Kilmarnock; Mr. Peter Fyfe, Glasgow; Mr. G. A. D. Mackay, Edinburgh; Mr. Kenneth Cameron, Aberdeen; Mr. George Mackay, Govan; Mr. William Mackison, Dundee; and Mr. J. C. Stobo, Rutherglen. This minute of the committee came up for confirmation at a meeting of council held on 10th September, and was unanimously adopted, with the addition of Mr. A. S. Edminston, Rutherglen; William Neilson, Falkirk; Dr. Nasmyth, Cowdenbeath; and Dr. Duncan, Crosshill, being added to the Board; the Board thus consisting of 17 members, 5 a quorum. At this meeting a committee was appointed to revise the constitution, and prepare a seal, woodcut, and die, for

the Association, this committee to consist of Mr. Peter Fyfe, George Mackay, John M'Neil, Dr. P. C. Smith, Dr. Cameron, Old Kilpatrick, and the secretary. The result of their labours is seen in the constitution now lying on the table, and in the seal, woodcut, and die, which you have all seen, and which, I am sure, all will readily admit, show a design at once appropriate and beautiful. This committee was also entrusted with the designing of a certificate of competency in sanitary science, which is also upon table.

We now come to what has been the great work of this bygone year, the inaugurating and carrying on examinations in sanitary science. I have called it a great work, inasmuch as the labour has been excessive, but much more so in the results that will be sure to follow. Our labour will save the time and trouble of County Councils, County Districts and Burghs, when choosing a sanitary inspector, in wading through piles of certificates and recommendations. Let the advertisement for a sanitary inspector state that none need apply who cannot produce a certificate of competency in sanitary science. The applicants will be few, but those few will be worth choosing from, without any other certificates whatever, except for moral character. We expect our labours will not only educate sanitary inspectors, but may be helpful to local authorities in enabling them to realize the magnitude of the danger to the health of their constituents, for the conserving of which all local authorities have been called into being, danger that comes from so many points, and from so many, so-called, small things, that require constant and unwearied vigilance to prevent them sapping the very foundations of health, comfort, and long life.

If the public, and more especially the health committees connected with local authorities, can be induced to study the syllabus of subjects we have framed, every one of which subjects has a special bearing upon the health of the community as well as each individual, and a full knowledge of which is necessary to the attaining of our Certificate of Competency, they will see the necessity of having the men, into whose hands they have placed such heavy responsibilities, being thoroughly trained for the duties, and when they have appointed them, help them in their work, and encourage them in every possible way, in the faithful and efficient discharge of their obligations.

The following is a copy of the syllabus referred to :—

A thorough knowledge of the "Public Health (Scotland) Act, 1867"; "Rivers Pollution Act, 1867"; Sale of Food and Drugs Act, 1875"; "Housing of Working Classes Act, 1885"; health clauses of "The Local Government (Scotland) Act, 1889"; "Cattle Sheds in Burghs (Scotland) Act, 1886"; "Notification of Diseases Act, 1889"; "Dairies, Cowsheds, and Milkshops Orders, 1879 to 1886"; "Bakehouses Act, 1863"; "Factory and Workshops Act, 1878"; "Factory and Workshops Amendment Act, 1883"; "Margarine Act, 1887"; "Artizans and Labourers' Dwellings Acts."

A knowledge of the Principles of Ventilation, and the Simple Methods of Ventilating Rooms. Measurement of Cubic Space.

A knowledge of the Physical Characteristics of Good Water; Methods of Water Supply; Means of Preventing Pollution; and the Conditions of Good Drainage.

A knowledge of the various Sanitary Appliances for Houses. Inspection of Builders' and Plumbers' Work.

A knowledge of what constitutes a Nuisance arising from any Trade, Business, or Manufacture.

A knowledge of the Characteristics of Good and Bad Food, so as to be able to recognize Unsoundness.

Some knowledge of Infectious Diseases, the Regulations affecting Persons suffering from such Diseases, and the Best Methods of Disinfection.

Methods of Inspecting Dwellings, Dairies, Milkshops, Markets, Slaughter-houses, Cowsheds, and Offensive Trades.

Scavenging and the disposal of Refuse.

Two examinations have been held: the first at Glasgow, within the halls of the Faculty of Physicians and Surgeons, 242 St. Vincent Street, on the 14th day of January; and the second at Edinburgh, within the halls of the College of Surgeons, on the 23rd day of April last. On both occasions the halls were placed at our service with the greatest cordiality by both the Faculties mentioned.

The following were the questions placed on the papers at the respective examinations:—

First Examination.

1. What are the chief duties of a sanitary inspector under the Public Health (Scotland) Act, 1867? Give a *resumé* of the principal sections referring to those duties, naming the sections.

2. Define what constitutes a nuisance within the meaning of the Public Health (Scotland) Act.

3. Describe your action, under the Food and Drugs Act, when you wish to take a sample for analysis, until the same is in the public analyst's hands.

4. What do you mean by constant and intermittent supply? What are the disadvantages of each, and what the advantages? How would you lessen waste of water in distribution?

5. What are the various forms of water-closets in use? Point out their defects. Describe in full the form of W.C. you would advise for public schools and institutions.

6. What means should be adopted to prevent air from sewers entering into a house? Illustrate your answer by sketches, if possible.

7. Describe the dry earth system. What soils are most useful? To what uses is it applicable? How would you deal with the slop waters?

8. How many cubic feet of breathing space would you allow to each inmate of a dwelling? A room measures 8 feet 6 inches by 11 feet 4 inches by 9 feet 3 inches in height. What is the cubic space? and how many persons would it be fitted to accommodate?

Second Examination.

1. State what are the principal component parts of the atmosphere, and their relative amounts in percentages, and state an easy and handy method whereby you could ascertain the presence of carbonic acid gas in the air of a sleeping compartment.

2. If there is reason to suspect that sewer gas is escaping in a house, in what way would you proceed to examine the drains and pipes, and what points would you look to? Write a report upon a supposed case, stating how the drains, soil pipes, and waste pipes should be arranged, so as to prevent any danger to the inmates.

3. An overcrowded house is found to have several lodgers. What steps can be taken by the Local Authority to remove the nuisance? Detail the legal provisions referring to such a case.

4. A trade, which is proposed to be established in a town, is objected to by the inhabitants. What remedies are at the disposal of the Local Authority, and of the public, to prevent its establishment, and what are the circumstances that would justify their opposition?

5. What are the points to be attended to by a sanitary inspector in visiting and reporting upon dairies and slaughter-houses?

6. A circular well, 3 feet in diameter, contains water to a depth of 6 feet. How many gallons does the well contain? How may the risks of pollution be prevented in shallow wells?

7. What diameter do you consider sufficient for a horizontal drain and a vertical soil-pipe in a tenement of three flats having twelve houses? State what kind of material should be used in such drain and soil-pipe.

8. Mention three diseased conditions of animals which produce corresponding diseases of man. What precautions might prevent these occurring?

At the first examination 18 candidates presented themselves, and 13 passed. At the second, 26 candidates, two of whom had failed on the previous occasion, presented themselves, of whom 18 passed. The names of the examiners and of the successful candidates were sent to the Board of Supervision as well as published in the newspapers. Another examination has been arranged for, to take place at Aberdeen on the first day of October next; and here again we are honoured by having the halls of the Marischal College placed at our services by the authorities of that ancient seat of learning.

We also printed a circular letter embodying our objects and claims to be recognised by all health authorities, and sent to about 400 Local Authorities in Scotland, which we hope may prove of some service.

The examinations have brought us in £88, 4s., and our ordinary income up till 1st July, £21, 2s. 8d.—£109, 6s. 8d. We have an expenditure of £47, 18s. On hand, £61, 8s. 8d.—£109, 6s. 8d. Of the £21, 2s. 8d. ordinary income, £13, 9s. have been subscribed by Local Authorities, and certainly they are entitled to require good work at our hands.

Let us, therefore, do all in our power to assist every Local Authority in Scotland to get rid of everything that is offensive to the eye or to the smell, as well as whatever is injurious to health. Let us devise means to teach the people, the humblest of the people, the unwisdom of living in a dark, damp, or badly ventilated house, simply because the rent is a little lower. The people need to be taught that it will pay far better in the end to pay less money to the tobacconist and the publican, and more to the landlord for a good comfortable house, where the children may

thrive, the mother be happy and contented, and the father proud to spend his evenings with his happy, healthy children, and his cheerful, loving wife, in his nice, sweet little home. Let our endeavour be to make our beloved land as celebrated for the purity of its dwellings as for the freshness of the mountain air, for the decency of its firesides as for the grandeur of its hills, and as celebrated for the health of its people as it has always been for its unspeakable beauty.

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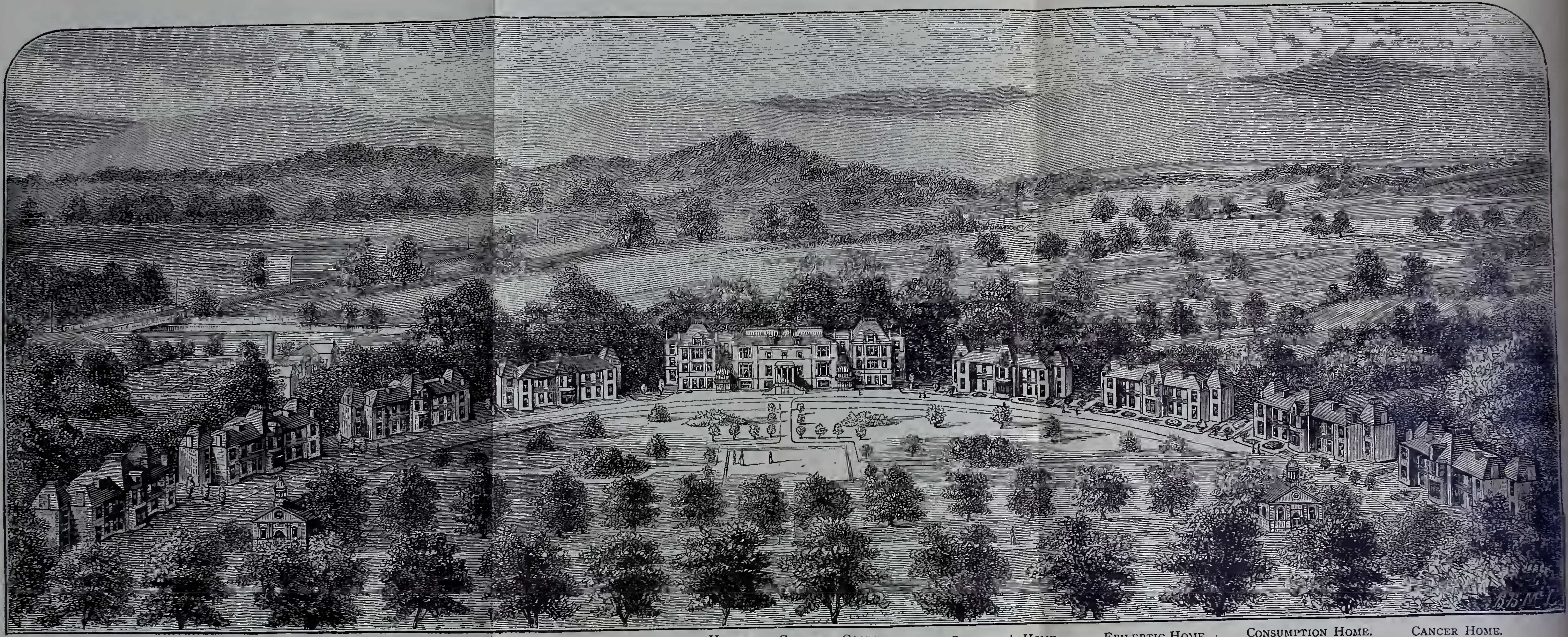

PROPOSED EXTENSION OF BROOMHILL HOME.